Valley Water

Annual Groundwater Report

for Calendar Year 2018

Santa Clara Valley Water District

Annual Groundwater Report for Calendar Year 2018

Prepared by

George Cook, P.G.
Senior Water Resources Specialist

Roger Pierno, P.E.
Associate Engineer

Under the Direction of:

Vanessa De La Piedra, P.E
Groundwater Management Unit Manager
Water Supply Division

Garth Hall, P.E.
Deputy Operating Officer
Water Supply Division

Nina Hawk
Chief Operating Officer
Water Utility Enterprise

Norma J. Camacho
Chief Executive Officer

Valley Water

Santa Clara Valley Water District

Annual Groundwater Report for Calendar Year 2018

Contributors

Chanie Abuye

Randy Behrens

Scott Elkins

Victoria Garcia

Ardy Ghoreishi

Simon Gutierrez

Bassam Kassab

Jeannine Larabee

Yaping Liu

Xiaoyong Zhan

Graphic Design

Joan Ang

BOARD OF DIRECTORS

Linda J. LeZotte
Chair, District 4

Nai Hsueh
Vice Chair, District 5

Barbara F. Keegan
District 2

Tony Estremera
District 6

John L. Varela
District 1

Richard P. Santos
District 3

Gary Kremen
District 7

TABLE OF CONTENTS

Page

EXECUTIVE SUMMARY ES-1

CHAPTER 1 - INTRODUCTION 1

CHAPTER 2 – GROUNDWATER PUMPING, RECHARGE, AND WATER BALANCE 5

2.1 Groundwater Pumping 5

2.2 Groundwater Recharge 14

2.3 Groundwater Balance 17

CHAPTER 3 – GROUNDWATER LEVELS AND STORAGE 20

3.1 Groundwater Levels 20

3.2 Groundwater Storage 26

CHAPTER 4 – LAND SUBSIDENCE 27

4.1 Extensometer Monitoring 27

4.2 Benchmark Elevation Surveys 28

4.3 Subsidence Index Wells 28

CHAPTER 5 – GROUNDWATER QUALITY 34

5.1 Regional Groundwater Quality 35

5.2 Groundwater Quality Trends 39

5.3 Domestic Well Water Quality 47

5.4 Recharge Water Quality 50

5.5 Monitoring Near Recycled Water Irrigation Sites 50

5.6 Salt and Nutrient Management Plans 56

5.7 Contaminant Release Sites 57

5.8 Well Ordinance Program 59

CHAPTER 6 – GROUNDWATER MANAGEMENT PLAN IMPLEMENTATION 61

6.1 Outcome Measure Performance and Action Plan 61

6.2 Status of Groundwater Management Plan Recommendations 62

6.3 Status of Sustainable Groundwater Management Act Compliance 67

LIST OF FIGURES

Figure 1. Santa Clara and Llagas Subbasins 3
Figure 2. Groundwater Benefit Zones and Local Cities 4
Figure 3. CY 2018 Zone W-2 Groundwater Pumping 7
Figure 4. CY 2018 Zone W-5 Groundwater Pumping 8
Figure 5. Countywide Groundwater Pumping and Managed Recharge 10
Figure 6. Countywide Water Use 11
Figure 7. Groundwater Pumping by Use Category 12
Figure 8. Percent of Total Pumping by Major Groundwater Users in 2018 13
Figure 9. Countywide Groundwater Pumping and Recharge in CY 2018 14
Figure 10. Valley Water Managed Recharge Facilities 15
Figure 11. Managed Recharge by Source - North County and South County 16
Figure 12. CY 2018 Groundwater Balance 19
Figure 13. CY 2018 Groundwater Level Monitoring 22
Figure 14. Groundwater Elevations at Regional Index Wells 23
Figure 15. Spring 2018 Groundwater Elevation Contours in the Principal Aquifer 24
Figure 16. Fall 2018 Groundwater Elevation Contours in the Principal Aquifer 25
Figure 17. CY 2018 Land Subsidence Monitoring 29
Figure 18. Cumulative Land Subsidence 30
Figure 19. Groundwater Levels at Santa Clara Plain Subsidence Index Wells (feet, NAVD88) 31
Figure 20. CY 2018 Groundwater Quality Monitoring Wells 36
Figure 21. CY 2018 MCL Exceedances at Water Supply Wells 38
Figure 22. Chloride Concentration Trends (2004 - 2018) 41
Figure 23. Nitrate Concentration Trends (2004 - 2018) 42
Figure 24. Total Dissolved Solids (TDS) Concentration Trends (2004 - 2018) 43
Figure 25. Groundwater and Salt Water Interaction in the Santa Clara Plain Shallow Aquifer 46
Figure 26. Nitrate Results for Domestic Wells Tested in 2018 48
Figure 27. Groundwater Monitoring Near Santa Clara Subbasin Recycled Water Irrigation Sites 53
Figure 28. Groundwater Monitoring Near Llagas Subbasin Recycled Water Irrigation Sites 55

LIST OF TABLES

Table ES-1. CY 2018 Groundwater Conditions Compared to Other Years....ES-3
Table ES-2. Summary of 2018 Outcome Measure Performance and Action Plan....ES-4
Table 1. CY 2018 Groundwater Pumping by Use (AF).... 5
Table 2. Number of Wells Reporting Groundwater Use in CY 2018.... 6
Table 3. CY 2018 Groundwater Pumping Compared to Other Periods (AF).... 9
Table 4. CY 2018 Managed Recharge (AF).... 14
Table 5. Groundwater Elevations at Regional Index Wells (feet, NGVD88).... 21
Table 6. Estimated End of Year Groundwater Storage (AF).... 26
Table 7. Median Nitrate and TDS by Subbasin and Aquifer Zone (mg/L).... 37
Table 8. Chloride, Nitrate, and TDS Concentration Trends (2004 - 2018).... 40
Table 9. Total Dissolved Solids and Nitrate Concentration Step Trends in Principal Aquifers.... 44
Table 10. 2018 Domestic Well Testing Results.... 49
Table 11. Summary of 2018 Groundwater Monitoring Events near Recycled Water Irrigation Sites.... 51
Table 12. Groundwater Quality Concentration Trends at Santa Clara Plain Recycled Water Irrigation Sites.... 52
Table 13. Groundwater Quality Concentration Trends at Llagas Subbasin Recycled Water Irrigation Sites.... 54
Table 14. Comparison of 2018 Median Concentrations with Projected 2018 SNMP Median Concentrations.... 56
Table 15. CY 2018 Valley Water Well Permit and Inspection Summary.... 59
Table 16. Summary of Outcome Measure Performance.... 61

LIST OF APPENDICES

Appendix A – 2018 Subsidence Data Analysis Report

Appendix B – 2018 Groundwater Quality Summary Provided to Well Owners

Appendix C – 2018 Groundwater Quality Results

Appendix D – 2018 Recharge Water Quality Results

Appendix E – 2018 Water Quality Evaluation at Recycled Water Irrigation Sites

Appendix F – Water Year 2018 Report for the Santa Clara and Llagas Subbasins (Submitted to the CA Department of Water Resources in March 2019)

This page is intentionally left blank.

EXECUTIVE SUMMARY

The Santa Clara Valley Water District (Valley Water) is the Groundwater Sustainability Agency (GSA) for the Santa Clara and Llagas subbasins[1] in Santa Clara County, which are sustainably managed through the comprehensive activities described in the District's 2016 Groundwater Management Plan (GWMP).[2] This Annual Groundwater Report for Calendar Year (CY) 2018 is separate from the annual report required under the Sustainable Groundwater Management Act (SGMA). This report describes groundwater use, levels, quality, storage, and land subsidence and presents the status of GWMP outcome measures using recent data. These measures, identified in the GWMP, are used to evaluate performance relative to Valley Water Board of Directors (Board) Water Supply Objective 2.1.1: "Aggressively protect groundwater from the threat of contamination and maintain and develop groundwater to optimize reliability and to minimize land subsidence and saltwater intrusion."

Groundwater pumping by water retailers and other well users was 119,000 acre-feet (AF), providing 41% of the total water used in the county in 2018. To help sustain and protect groundwater supplies, in 2018 Valley Water:

- Recharged groundwater with 105,400 AF of local and imported surface water,
- Reduced groundwater demands by 203,300 AF through treated surface water and recycled water deliveries and water conservation programs (which collectively provide in-lieu groundwater recharge),
- Conducted extensive monitoring and analysis of groundwater levels and quality, and land subsidence,
- Implemented the well ordinance program and other activities to minimize threats to groundwater quality, and
- Worked with basin stakeholders, land use agencies, and regulatory agencies to protect groundwater resources.

Table ES-1 shows data for key indicators in 2018 as compared to 2017 and prior periods. Having previously fully recovered from the 2012-2016 drought, groundwater levels and storage continued their rise, with an estimated 10,600 AF[3] added to groundwater storage in 2018 since recharge exceeded pumping. Groundwater levels equaled or exceeded previous historical highs in regional index wells and at many other wells around the county. Estimated end of 2018 total groundwater storage was 352,500 AF, which falls well within the "Normal" stage (Stage 1) of the District's Water Shortage Contingency Plan, indicating good water supply conditions.

Groundwater quality remained generally good in the three principal aquifer zones; median values for Total Dissolved Solids (TDS) were at or below 400 milligrams per liter (mg/L) in all groundwater management areas. Median nitrate values were below the drinking water standard of 10 mg/L in all three management areas, with values in the Santa Clara Plain and Coyote Valley Subbasin well below 10 mg/L (3.3 and 3.8 mg/L, respectively) while the Llagas Subbasin was higher at 6.0 mg/L. As described below, Valley Water continues to work with regulatory and land use agencies to address this ongoing groundwater protection challenge.

North County Groundwater Summary

Groundwater use in the Santa Clara Plain (the northern Santa Clara Subbasin) was 63,600 AF in 2018, a 9% decrease from 2017. This is below the long-term average of 92,000 AF due to continued lower demand and increased use of treated surface water by water retailers. Pumping locations and uses remained relatively stable, with nearly all (99%) groundwater used for municipal and industrial (M&I) purposes.

---

[1] California Department of Water Resources (DWR) Basins 2-9.02 and 3-3.01, respectively. Valley Water further divides the Santa Clara Subbasin into two groundwater management areas: the Santa Clara Plain and the Coyote Valley.

[2] Santa Clara Valley Water District, Groundwater Management Plan, November 2016. This plan was submitted to DWR as an Alternative to a Groundwater Sustainability Plan in December 2016 and approved for SGMA compliance in July 2019.

[3] Groundwater storage estimates presented in this report are as of March 2019, and represent accumulated storage as described further in Chapter 3. Storage estimates are updated as additional data becomes available.

Groundwater levels remained fully recovered from the recent drought, with water levels in many wells at or above historical highs. The high groundwater levels are also well above the minimum water level thresholds established to protect against land subsidence. Land subsidence data for 2018 actually indicates uplift, reflecting healthy groundwater conditions. Estimated groundwater storage at the end of 2018 was 324,200 AF, which was 18,800 AF higher than 2017.

North County groundwater continues to have very good quality overall. In 2018, 99% of water supply wells tested met all health-based drinking water standards (one well had elevated nitrate and two wells had elevated detections of 1,2,3-Trichloropropane). Public water systems must comply with drinking water standards, which may require treatment or blending prior to delivery.

South County Groundwater Summary

In 2018, groundwater pumping in the Coyote Valley (the southern Santa Clara Subbasin) and Llagas Subbasin was 12,000 AF and 43,300 AF, respectively. Pumping decreased by 3% in the Coyote Valley and increased by 4% in the Llagas Subbasin compared to 2017. Most pumping in the Coyote Valley was for M&I uses (72%), with smaller amounts for agricultural (26%) and domestic (2%) uses. In the Llagas Subbasin, 55% of total pumping was for agriculture, 40% for M&I use and less than 5% for private domestic use. Estimated groundwater storage in South County at the end of 2018 was 28,300 AF, which is 8,200 AF lower than 2017. Groundwater levels remained healthy and were well above historical lows at regional index wells.

Groundwater quality in South County is generally good, with most water supply wells meeting drinking water standards. However, nitrate continues to be a significant groundwater quality challenge; it was detected above the drinking water standard in 22% of South County water supply wells tested in 2018 (primarily domestic wells). As described in the outcome measure summary below, Valley Water continues to work to address this challenge.

Perchlorate contamination in the Llagas Subbasin from a former highway safety flare plant has been substantially reduced due to ongoing managed recharge by Valley Water and active remediation by the responsible party. The perchlorate plume, which once extended from Tennant Avenue in Morgan Hill to Gilroy (about 10 miles), now extends from Morgan Hill to the San Martin Airport, shrinking to about 3 miles. Cleanup continues to make progress, with users of seven domestic wells currently requiring replacement water. Valley Water continues to monitor related activities and advocate for expedited and thorough cleanup.

Table ES- 1. CY 2018 Groundwater Conditions Compared to Other Years

Index – Groundwater Supply[1]	2018	Compared to 2017	Compared to 5-Year Average (2014 - 2018)
Managed Recharge (AF)	105,400	Up 9%	Up 32%
Groundwater Pumping (AF)	119,000	Down 3%	Down 6%
Groundwater as % of Total Water Use	41%	Down 1%	Down 2%
Groundwater Levels (feet, NGVD88)[2]			
Santa Clara Plain	92.6	Down 1.2 feet	Up 24.5 feet
Coyote Valley	272.9	Up 8.3 feet	Up 4.6 feet
Llagas Subbasin	223.6	Up 10.7 feet	Down 12.9 feet
End of Year Groundwater Storage (AF)	353,000	Up 3%	Up 19%
Land Subsidence (feet/year)[3]	-0.004 (Uplift)	Uplift	Uplift
Index - Groundwater Quality[4]	**2018**	**5-Year Step Trend[5]**	**10-Year Step Trend**
Total Dissolved Solids (TDS, mg/L)			
Santa Clara Plain	400	No Change	No Change
Coyote Valley	394	Increase	No Change
Llagas Subbasin	387	No Change	No Change
Nitrate (as Nitrogen, mg/L)			
Santa Clara Plain	3.3	No Change	No Change
Coyote Valley	3.8	Decrease	No Change
Llagas Subbasin	6	Increase	No Change

1. Groundwater supply and quality indices are shown for three groundwater management areas: the Santa Clara Plain and Coyote Valley (which comprise the Santa Clara Subbasin) and the Llagas Subbasin.
2. Groundwater elevations represent the average of all readings at three regional groundwater level index wells for the time period noted based on the National Geodetic Vertical Datum of 1988.
3. Valley Water calculates the subsidence using the average measured subsidence at two extensometers over the most recent 11-year period. Measured compaction is below the established tolerable rate of 0.01 feet/year, and throughout 2018, water levels at all ten subsidence index wells were above related thresholds established to prevent permanent subsidence.
4. Values represent the median groundwater concentration for principal aquifer zone wells tested (both water supply wells and monitoring wells).
5. The median 2018 concentration for each groundwater management area was compared to that of 5 years ago (2013) and 10 years ago (2008) to determine if there is any statistically significant difference using the Mann-Whitney test at the 95% confidence level.

Outcome Measure Summary

The GWMP identifies outcome measures to assess performance relative to Board policy and groundwater sustainability goals. The status of these measures using 2018 data is shown in Table ES-2 below, along with actions to address measures not being met. All outcome measures related to groundwater storage, levels, and land subsidence were met in 2018. Continued sustainable groundwater supply conditions demonstrate the effectiveness of significant investments in basin management facilities, diverse water supplies, and conjunctive water management, as well as close coordination with water retailers.

Elevated nitrate continues to be the primary groundwater protection challenge, particularly in South County, where a significant number of domestic wells contain water with nitrate above the drinking water standard. Valley Water continues to coordinate with land use and regulatory agencies to influence related policies, regulations, and decisions. More directly, the District's managed recharge programs help dilute nitrate and water quality testing and treatment system rebates help to reduce well owner exposure. While most wells have stable or decreasing long-term chloride concentrations, increasing concentrations in some shallow aquifer wells warrant further evaluation.

Table ES- 2. Summary of 2018 Outcome Measure Performance and Action Plan

Groundwater Storage	**OM 2.1.1.a.** Greater than 278,000 AF of projected end of year groundwater storage in the Santa Clara Plain. **Measure met:** Estimated end of 2018 storage: 324,200 AF **OM 2.1.1.b.** Greater than 5,000 AF of projected end of year groundwater storage in the Coyote Valley. **Measure met:** Estimated end of 2018 storage: 7,600 AF **OM 2.1.1.c.** Greater than 17,000 AF of projected end of year groundwater storage in the Llagas Subbasin. **Measure met:** Estimated end of 2018 storage: 20,700 AF
Groundwater Levels and Subsidence	**OM 2.1.1.d.** 100% of subsidence index wells with groundwater levels above subsidence thresholds. **Measure met:** All ten wells had groundwater levels above thresholds in 2018.
Groundwater Quality	**OM 2.1.1.e.** At least 95% of countywide water supply wells meet primary drinking water standards. **Measure not met:** Only 86% of water supply wells tested in 2018 had water that met primary drinking water standards due to elevated nitrate, mainly in South County domestic wells. If nitrate is not included, 100% of water supply wells met primary drinking water standards. **OM 2.1.1.f.** At least 90% of Coyote Valley and Llagas Subbasin wells meet Basin Plan agricultural objectives. **Measure met:** Nearly all wells (97%) had water that met agricultural objectives.
	Action Plan for OM 2.1.1.e: Implement Salt and Nutrient Management Plans to address nitrate, continue free domestic well testing and nitrate treatment system rebate programs, and continue collaborating with regulatory and land use agencies to address nitrate loading.
Groundwater Quality Trends	**OM 2.1.1.g.** At least 90% of wells in both the shallow and principal aquifer zones have stable or decreasing concentrations of nitrate, chloride, and Total Dissolved Solids. **Measure partially met:** This measure is not met for chloride, with 82% of wells having water with stable or decreasing concentration trends. The measure is met for nitrate and Total Dissolved Solids, with stable or decreasing concentrations observed in 91% and 92% of wells, respectively.
	Action Plan for OM 2.1.1.g: Implement Salt and Nutrient Management Plans to address salt loading, continue collaborating with regulatory and land use agencies.

Status of Sustainable Groundwater Management Act (SGMA) Compliance

In July 2019, DWR released their assessment of fifteen Alternatives to a Groundwater Sustainability Plan (GSP) submitted for SGMA compliance by Valley Water and other agencies. DWR approved Valley Water's GWMP for the Santa Clara and Llagas subbasins, finding it satisfies the objectives of SGMA. The next five-year update of the GWMP must be submitted to DWR by January 2022. Valley Water has submitted two annual reports for these subbasins (as required by SGMA), with the most recent submittal (March 2019) included as an appendix to this report.

As the GSA for the small portions of the North San Benito Subbasin[4] in Santa Clara County, Valley Water is supporting San Benito County Water District efforts to develop a GSP for the entire subbasin.

Groundwater Management Plan Implementation

To maintain sustainable groundwater conditions, Valley Water continues to implement the proactive groundwater management activities described in the GWMP. Chapter 6 of this report summarizes the status of the six major GWMP recommendations. Notable progress includes continued investment in high-priority capital projects (including dam safety and purified recycled water), the decision to participate in the California WaterFix[5], and coordination with water retailers and other stakeholders to develop a process to regulate groundwater extraction under SGMA, if needed.

Continued groundwater sustainability is central to the Valley Water mission to provide Silicon Valley safe, clean water for a healthy life, environment, and economy. As such, Valley Water will continue to "aggressively protect groundwater from the threat of contamination and maintain and develop groundwater to optimize reliability and to minimize land subsidence and saltwater intrusion," in accordance with Board policy.

[4] This subbasin is primarily located in San Benito County, where the San Benito County Water District (SBCWD) is the GSA. In 2019, DWR approved a basin boundary modification creating the North San Benito Subbasin through consolidation of several subbasins. The subbasins consolidated into the North San Benito Subbasin include the former Hollister and San Juan Bautista subbasins, which extend into Santa Clara County.

[5] The project name and scope changed in 2019. The project is now known as the Delta Conveyance Project and focuses on a single tunnel per direction from Governor Newsom.

This page is intentionally left blank.

CHAPTER 1 - INTRODUCTION

The Santa Clara Valley Water District (Valley Water) has the responsibility and authority to manage the Santa Clara and Llagas groundwater subbasins in Santa Clara County per the California legislature.[6] Valley Water also formally became the Groundwater Sustainability Agency (GSA) for these subbasins in 2016. Valley Water's comprehensive groundwater management activities and investments, described in the 2016 Groundwater Management Plan (GWMP)[7], have resulted in sustainable groundwater conditions for many decades. Valley Water's groundwater management objectives and authority under the Santa Clara Valley Water District Act (District Act) are to recharge groundwater basins, conserve, manage and store water for beneficial and useful purposes, increase water supply, protect surface water and groundwater from contamination, prevent waste or diminution of the water supply, and do any and every lawful act necessary to ensure sufficient water is available for present and future beneficial uses.

Valley Water Board of Directors (Board) Water Supply Objective 2.1.1 reflects the mission to protect groundwater resources: ***"Aggressively protect groundwater from the threat of contamination and maintain and develop groundwater to optimize reliability and to minimize land subsidence and salt water intrusion."*** Pursuant to the District Act and Board policy, Valley Water identifies the following basin management objectives in the GWMP:[8]

- Groundwater supplies are managed to optimize water supply reliability and minimize land subsidence.
- Groundwater is protected from existing and potential contamination, including salt water intrusion.

Purpose

This annual report describes groundwater conditions in the Santa Clara and Llagas subbasins for Calendar Year (CY) 2018 including groundwater use, recharge, water levels, water balance, storage, quality, and land subsidence. The following outcome measures (OM) derived from the GWMP are also assessed to evaluate performance in meeting Water Supply Objective 2.1.1:

- OM 2.1.1.a Greater than 278,000 AF[9] of projected end of year groundwater storage in the Santa Clara Plain.[10]
- OM 2.1.1.b Greater than 5,000 AF of projected end of year groundwater storage in the Coyote Valley.
- OM 2.1.1.c Greater than 17,000 AF of projected end of year groundwater storage in the Llagas Subbasin.
- OM 2.1.1.d 100% of Santa Clara Plain subsidence index wells with groundwater levels above subsidence thresholds.
- OM 2.1.1.e At least 95% of countywide water supply wells meet primary drinking water standards.
- OM 2.1.1.f At least 90% of Coyote Valley and Llagas Subbasin wells meet Basin Plan agricultural objectives.
- OM 2.1.1.g At least 90% of wells have stable or decreasing concentrations of nitrate, chloride, and total dissolved solids.

---

[6] Santa Clara Valley Water District Act, Water Code Appendix, Chapter 60.
[7] Santa Clara Valley Water District, Groundwater Management Plan, November 2016.
[8] Valley Water submitted this plan to the California Department of Water Resources as an Alternative to a Groundwater Sustainability Plan for Sustainable Groundwater Management Act compliance.
[9] AF = acre-feet. One acre-foot is equal to 325,851 gallons.
[10] As described subsequently, Valley Water divides the Santa Clara Subbasin into two groundwater management areas: the Santa Clara Plain and the Coyote Valley.

The Santa Clara and Llagas subbasins, located in Santa Clara County, are identified by the California Department of Water Resources (DWR) as Basin 2-9.02 and Basin 3-3.01, respectively (Figure 1). Valley Water divides the Santa Clara Subbasin into two groundwater management areas, the Santa Clara Plain and the Coyote Valley, due to different land use and management characteristics. The Santa Clara and Llagas subbasins are separated by a groundwater divide near Cochrane Road in Morgan Hill. Groundwater in the Santa Clara Subbasin generally flows toward San Francisco Bay, while flow in the Llagas Subbasin is generally to the southeast toward the Pajaro River. The Santa Clara Plain and Llagas Subbasin have both confined and recharge areas. Within the confined areas, low permeability clays and silts separate shallow and principal aquifers, with the latter defined as aquifer materials greater than 150 feet below ground surface. The recharge areas are unconfined as there are no laterally extensive aquitards forming distinct shallow and principal aquifer zones.

The information in this report is summarized by groundwater management area or by groundwater charge zone (Figure 2). Groundwater charge zones, or groundwater benefit zones, are areas where Valley Water collects fees from groundwater users based on the benefits received from Valley Water groundwater management activities. Zone W-2 (North County) generally coincides with the Santa Clara Plain, while Zone W-5 (South County) generally overlaps the combined area of the Coyote Valley and Llagas Subbasin.

Report Content

In addition to this Introduction, this Annual Groundwater Report for 2018 includes the following chapters:

- Chapter 2: Groundwater Pumping, Recharge, and Water Balance
- Chapter 3: Groundwater Levels and Storage
- Chapter 4: Land Subsidence
- Chapter 5: Groundwater Quality
- Chapter 6: Other Groundwater Management Activities
- Chapter 7: Conclusions

Figure 1. Santa Clara and Llagas Subbasins

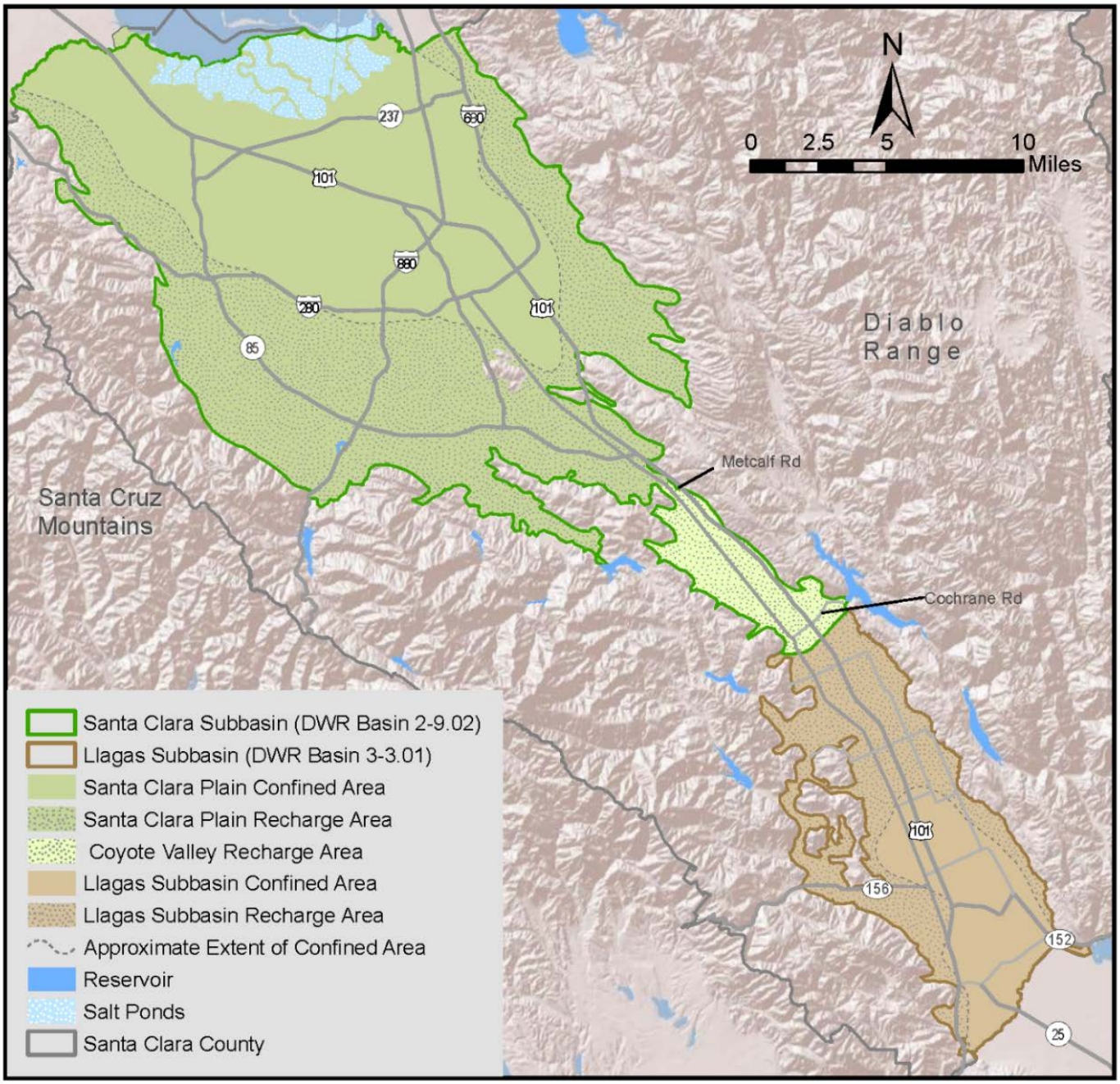
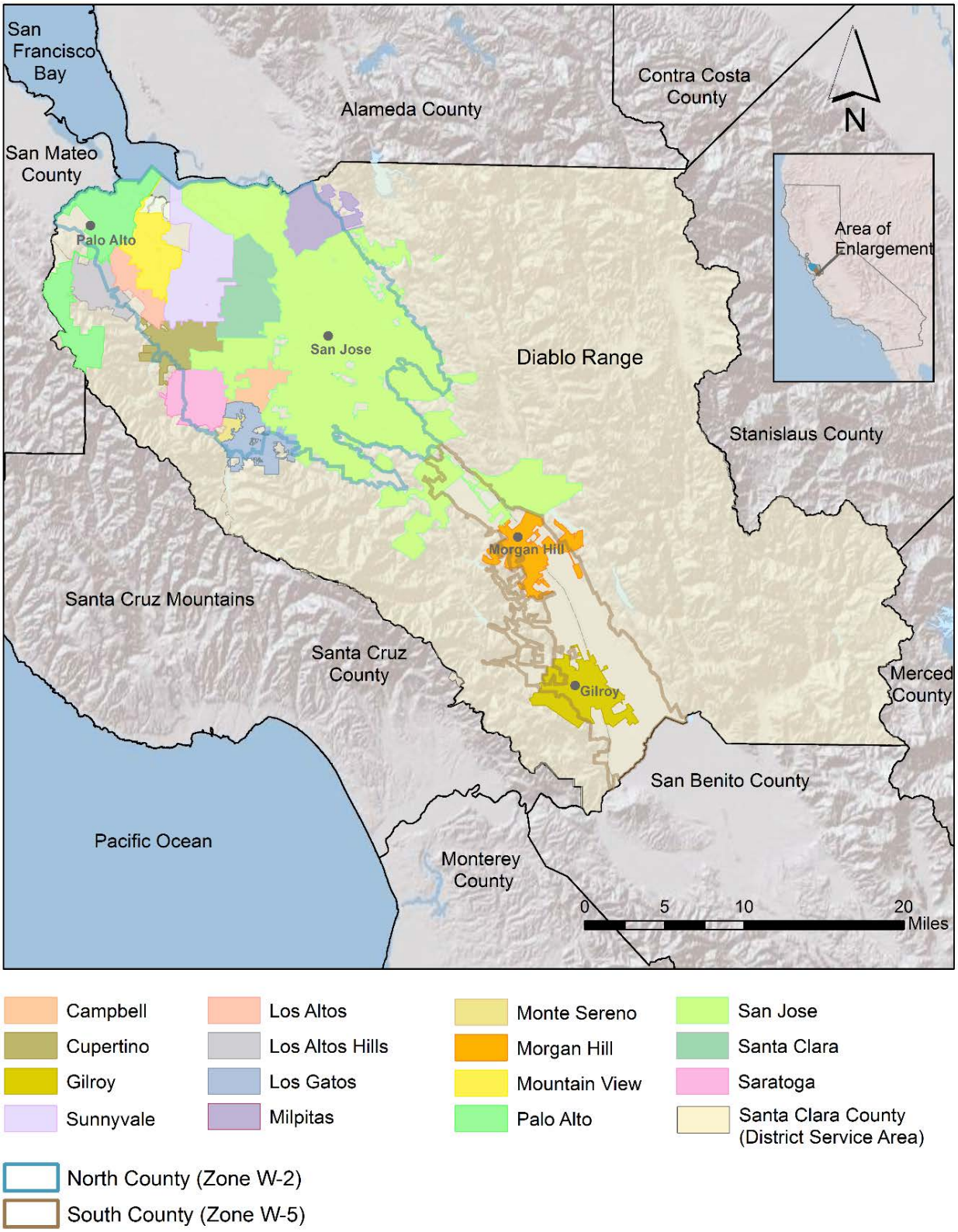


Figure 2. Groundwater Benefit Zones and Local Cities



CHAPTER 2 – GROUNDWATER PUMPING, RECHARGE, AND WATER BALANCE

Total groundwater pumping for 2018 in Zones W-2 and W-5 was 119,000 AF, providing 41% of the total water used[11] by county residents and businesses. Compared to 2017, groundwater pumping decreased 9% in the Santa Clara Plain and 3% in the Coyote Valley, but increased 4% in the Llagas Subbasin. Valley Water used about 105,000 AF of local and imported surface water to replenish the groundwater subbasins. In-lieu recharge, including treated and recycled water deliveries and water conservation programs, reduced demands on groundwater by approximately 203,000 AF.

Managed recharge provided about 70% of the total inflow to the subbasins and groundwater pumping accounted for over 85% of outflows. Due to good water supply conditions, the inflows exceeded the outflows, resulting in a net increase in countywide groundwater storage of 10,600 AF from 2017 to 2018.

2.1 Groundwater Pumping

Approximately 119,000 AF of groundwater was pumped in 2018, compared to 124,000 AF in 2017. Figures 3 and 4 show the locations and volumes of groundwater pumping and Table 1 summarizes the pumping by groundwater management area and use category.

Groundwater in North County is used primarily for Municipal and Industrial (M&I) purposes, with minimal agricultural or domestic use. In South County, agricultural use is more significant. This is especially evident in the Llagas Subbasin, where 55% of the use is for agriculture. While the quantity of groundwater used for domestic purposes is relatively small in South County, 74% of the 3,900 individual wells reporting using groundwater in South County were domestic wells. (Table 2).

Table 1. CY 2018 Groundwater Pumping by Use (AF)

Use	Zone W-2 North County	Zone W-5 South County		Total
	Santa Clara Plain	Coyote Valley	Llagas Subbasin	
Municipal & Industrial (M&I)	62,900	8,700	17,500	89,100
Domestic	200	200	1,800	2,200
Agricultural	500	3,100	24,000	27,600
Total	**63,600**	**12,000**	**43,300**	**118,900**

Note: Large volume pumpers are metered and report groundwater production to Valley Water monthly. Pumping for wells reporting semi-annually or annually (primarily domestic and agricultural) was estimated based on available data and/or prior year data as validated data was not available by the date of publication of this report.

[11] Total water use in the county was 294,000 AF and it came from groundwater pumping (40.5%), Valley Water treated water deliveries (36.8%), San Francisco Public Utilities Commission supplies to local retailers (13.5%), recycled water deliveries (6.1%), raw surface water deliveries (0.7%), and San Jose Water Company and Stanford water rights (2.3%). This total does not reflect groundwater pumping in bedrock areas outside Zones W-2 and W-5; these areas are sparsely populated compared to the valley floor, with presumed low water use.

Table 2. Number of Wells Reporting Groundwater Use in CY 2018

Use	Zone W-2 North County	Zone W-5 South County		Total
	Santa Clara Plain	Coyote Valley	Llagas Subbasin	
Municipal & Industrial (M&I)	723	69	290	1,082
Domestic	320	348	2,547	3,215
Agricultural	41	94	587	722
Total	**1,084**	**511**	**3,424**	**5,019**

Note: Some wells may report pumping for more than one use category (e.g., domestic and agricultural). The number of wells reporting semi-annually or annually (primarily domestic and agricultural) was estimated based on prior year as validated data was not available by the date of publication of this report.

The remainder of this page is intentionally left blank

Figure 3. CY 2018 Zone W-2 Groundwater Pumping

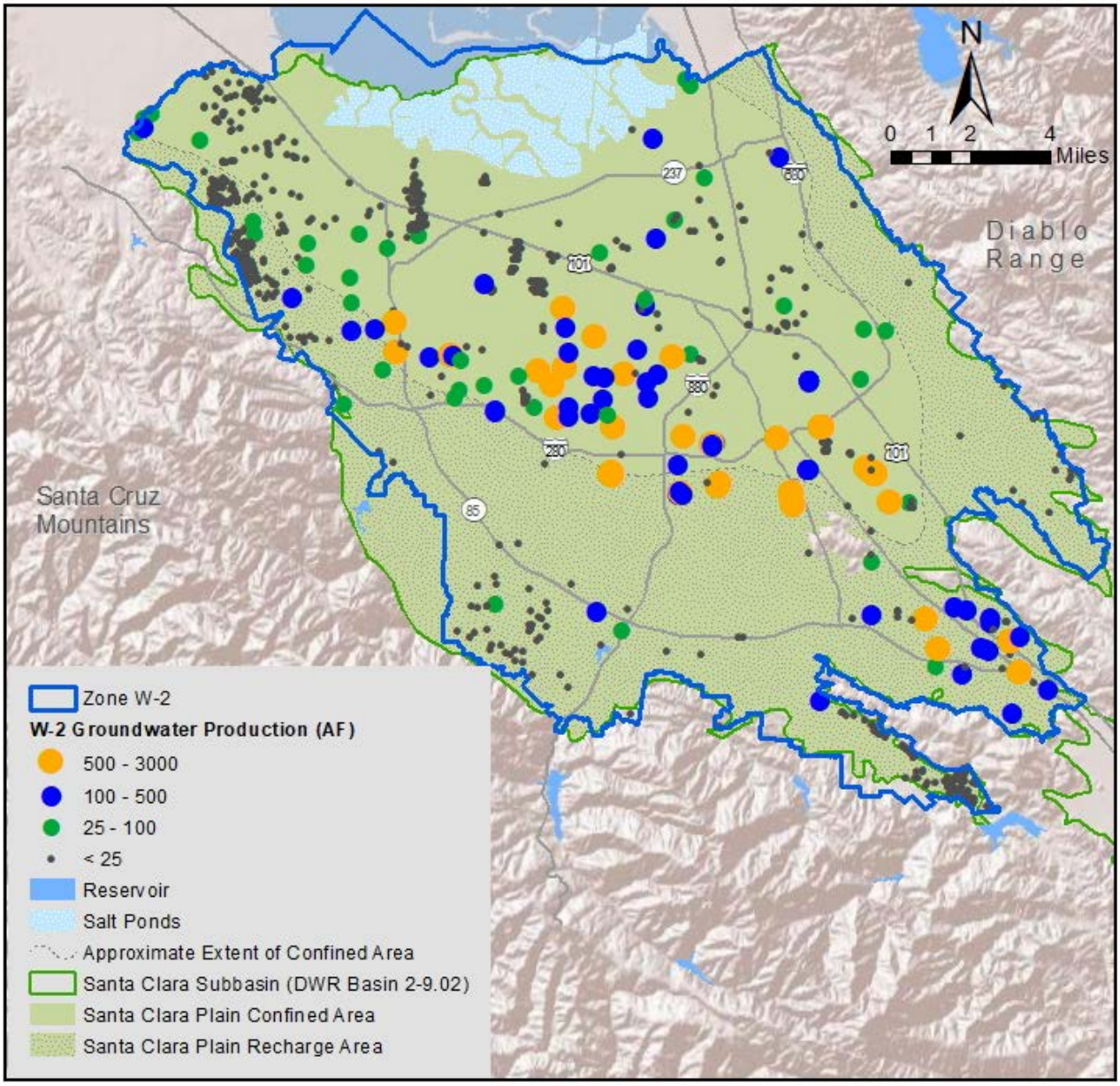
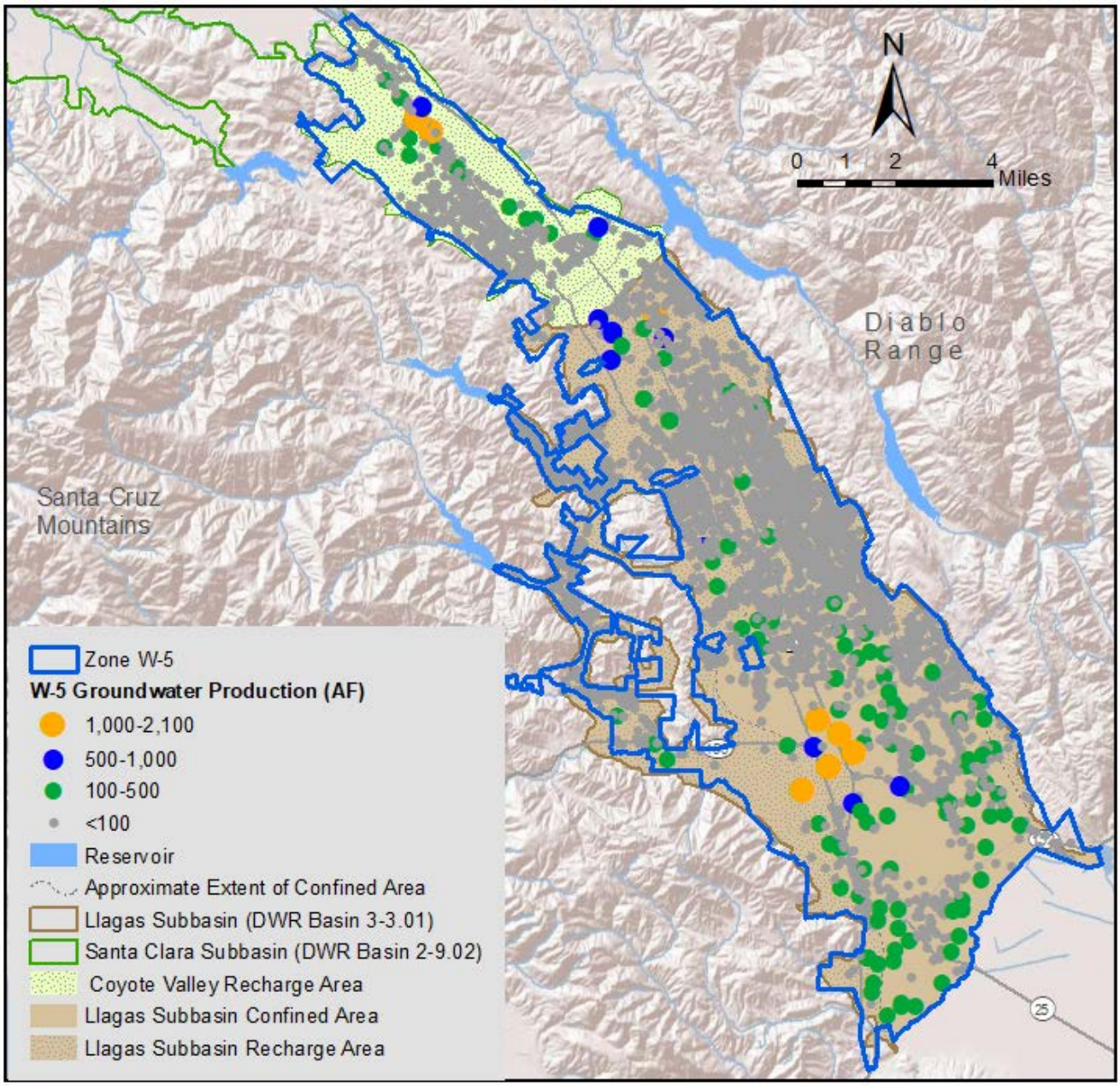


Figure 4. CY 2018 Zone W-5 Groundwater Pumping



Groundwater Pumping Trends

Countywide, total water use was 294,000 AF in 2018, similar to 2017 (293,000 AF). Countywide groundwater pumping was down 4% from the previous year, below the recent five-year average, and below the average over the period of record. This is largely driven by low pumping in the Santa Clara Plain (Table 3). Groundwater use decreased 9% in the Santa Clara Plain and 3% in the Coyote Valley but increased 4% in the Llagas Subbasin. Groundwater pumping is largely offset by Valley Water's managed recharge of local and imported surface water (Figure 5). Managed recharge typically averages about two thirds of the pumping, with natural recharge balancing the remaining pumping. Figure 6 shows the countywide water use by source, including groundwater, Valley Water treated water, San Francisco Public Utility Commission (SFPUC) supplies, local surface water, and recycled water. Groundwater provided 41% of the total water used countywide in 2018.

Groundwater pumping and use patterns over time are shown in Figure 7 for each of the groundwater management areas. In the Santa Clara Plain, pumping dropped significantly in the late 1980s following completion of Valley Water's Santa Teresa Water Treatment Plant (WTP). Since then, pumping has averaged 98,000 AF per year. Pumping spiked in the middle of the recent drought to 115,000 AF in 2014; however, the water retailers and community responded to the Valley Water Board's calls for water use reduction, and pumping decreased significantly during the past four years, averaging about 64,000 AF per year (AFY). A notable increase in pumping in the Coyote Valley occurred in 2006 when a water retailer installed new wells and began extracting water to serve customers in the Santa Clara Plain. This increased the average annual pumping volume by about 5,000 AF in Coyote Valley as reflected in Table 3. Pumping in the Llagas Subbasin has remained relatively stable over the period of record.

Table 3. CY 2018 Groundwater Pumping Compared to Other Periods (AF)

Period	Zone W-2 North County	Zone W-5 South County		Total
	Santa Clara Plain	Coyote Valley	Llagas Subbasin	
2018	63,600	12,000	43,300	118,900
2017	69,600	12,400	41,700	123,700
5 Year Average (2014-2018)	73,900	11,100	41,900	126,900
Period of Record (Average)	107,800	7,300	40,400	155,500

Note: The period of record is 1981-2018 for the Santa Clara Plain and 1988-2018 for the Coyote Valley and Llagas Subbasin.

Major Groundwater Users

The largest groundwater users in each zone are shown in Figure 8. Water retailers are the primary users in North County, accounting for over 89% of all pumping in 2018. San Jose Water Company is the largest individual user, followed by other retailers and a few large industrial users. Unlike North County, 52% of pumping in South County was from thousands of individual pumpers including agricultural and domestic users. In South County, pumping by water retailers and water companies accounted for 39% of groundwater use. Other large users include golf courses and industrial facilities.

Figure 5. Countywide Groundwater Pumping and Managed Recharge

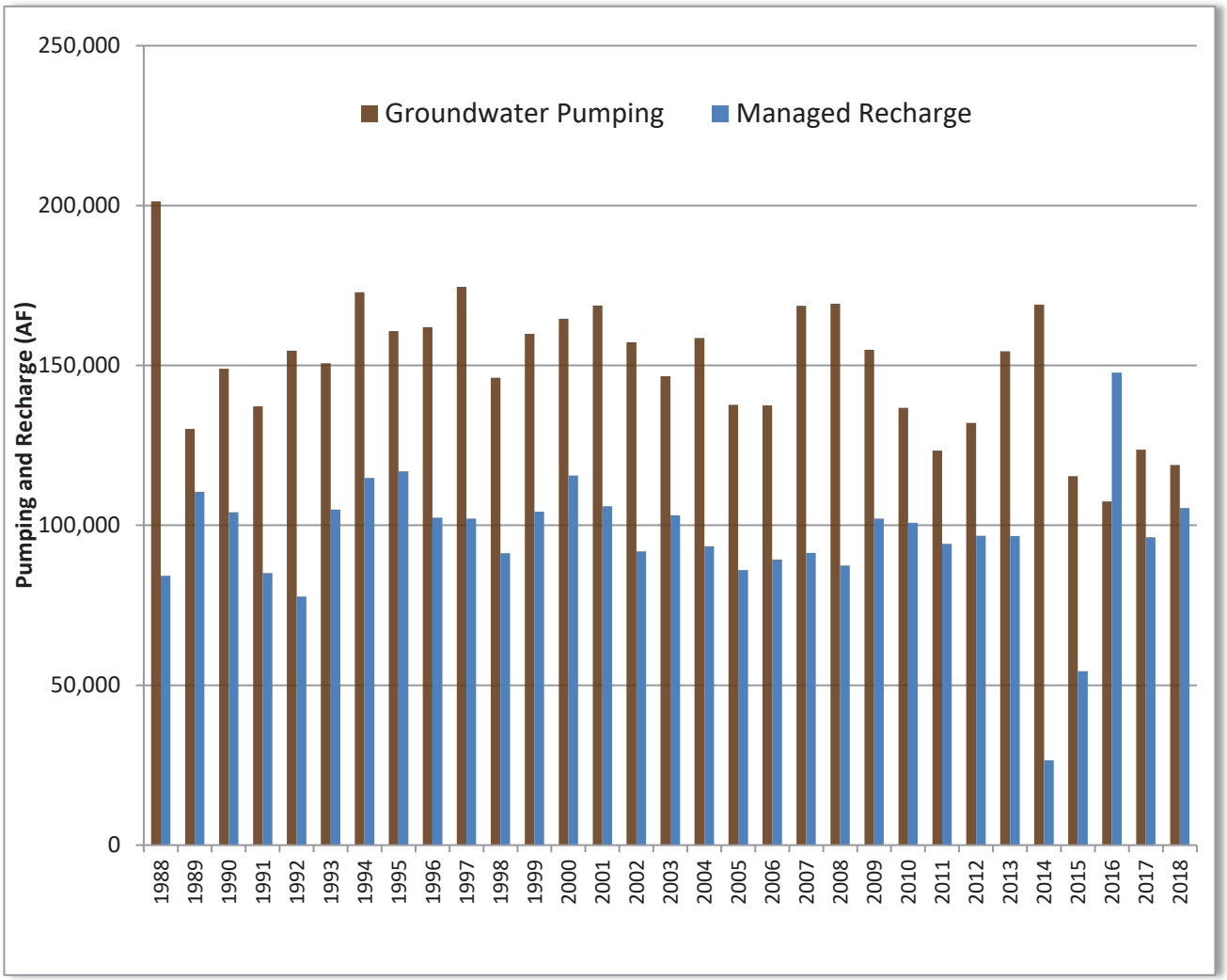
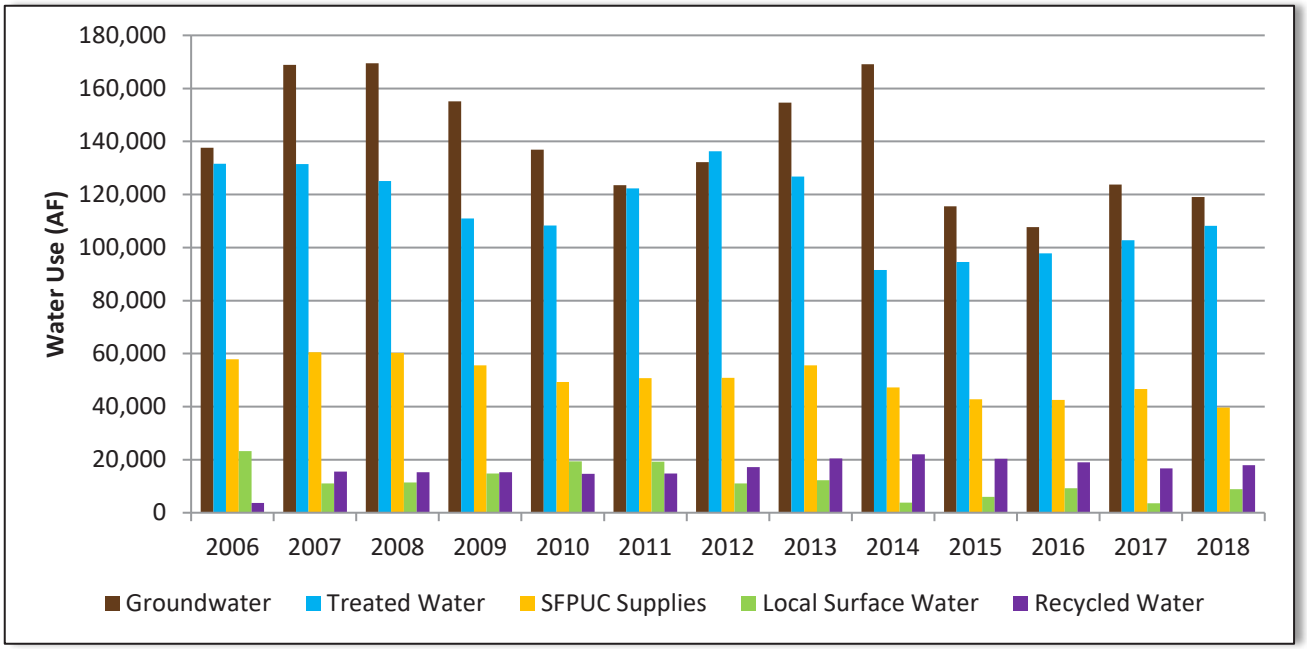


Figure 6. Countywide Water Use



The remainder of this page is intentionally left blank

Figure 7. Groundwater Pumping by Use Category

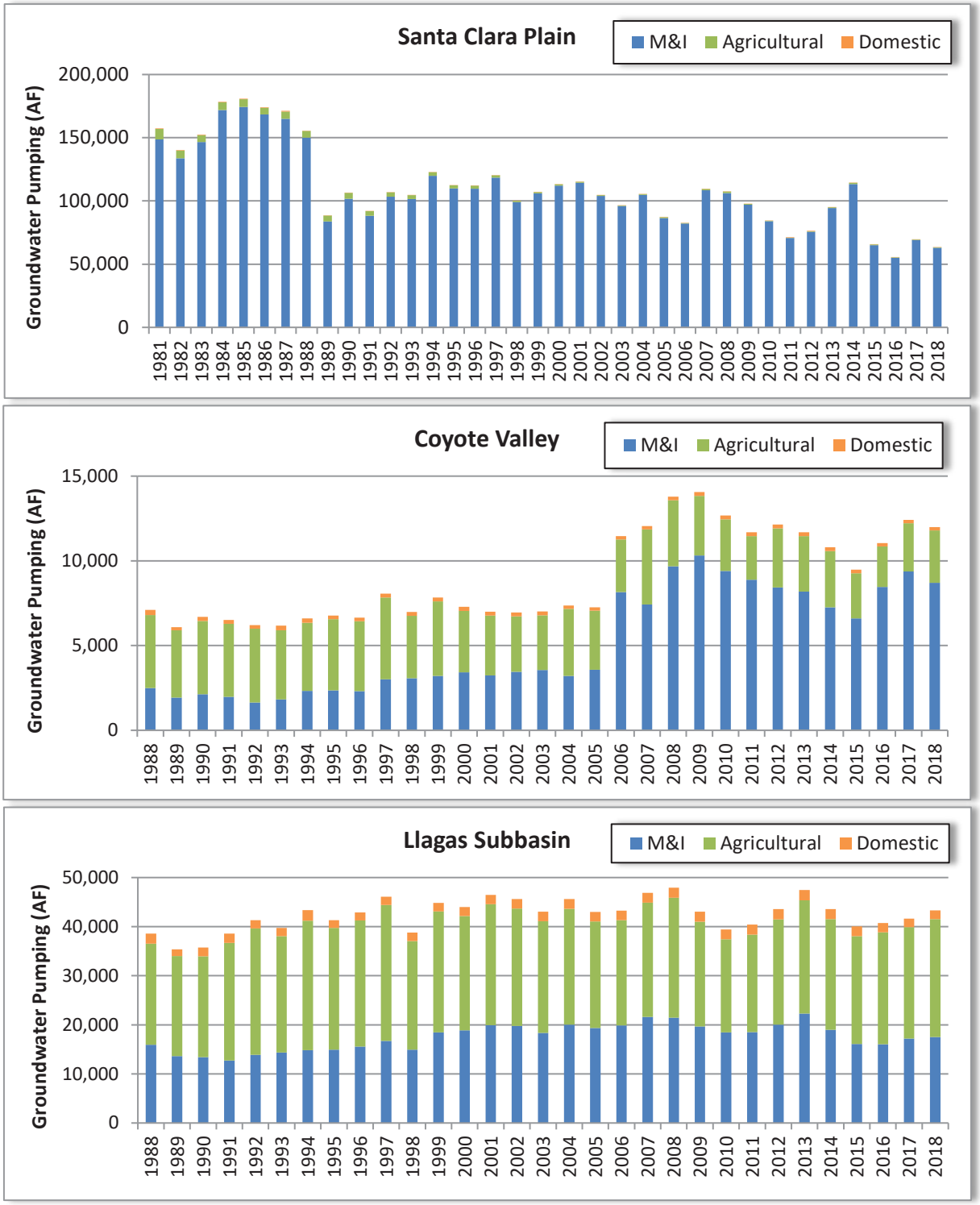
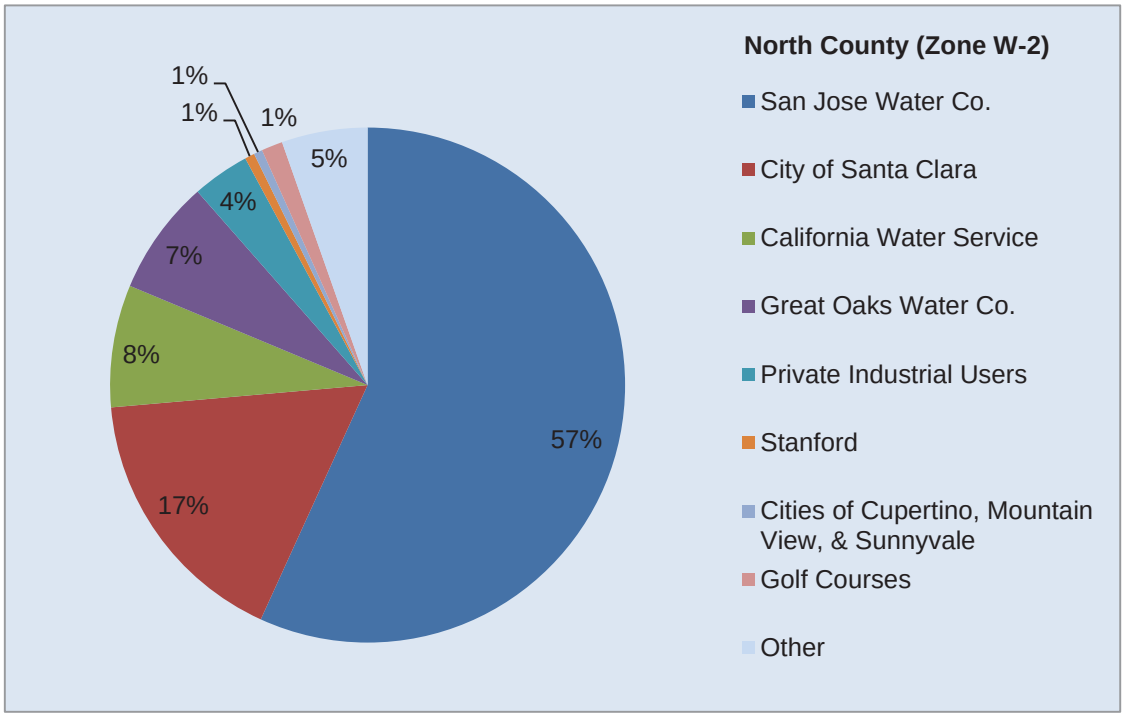
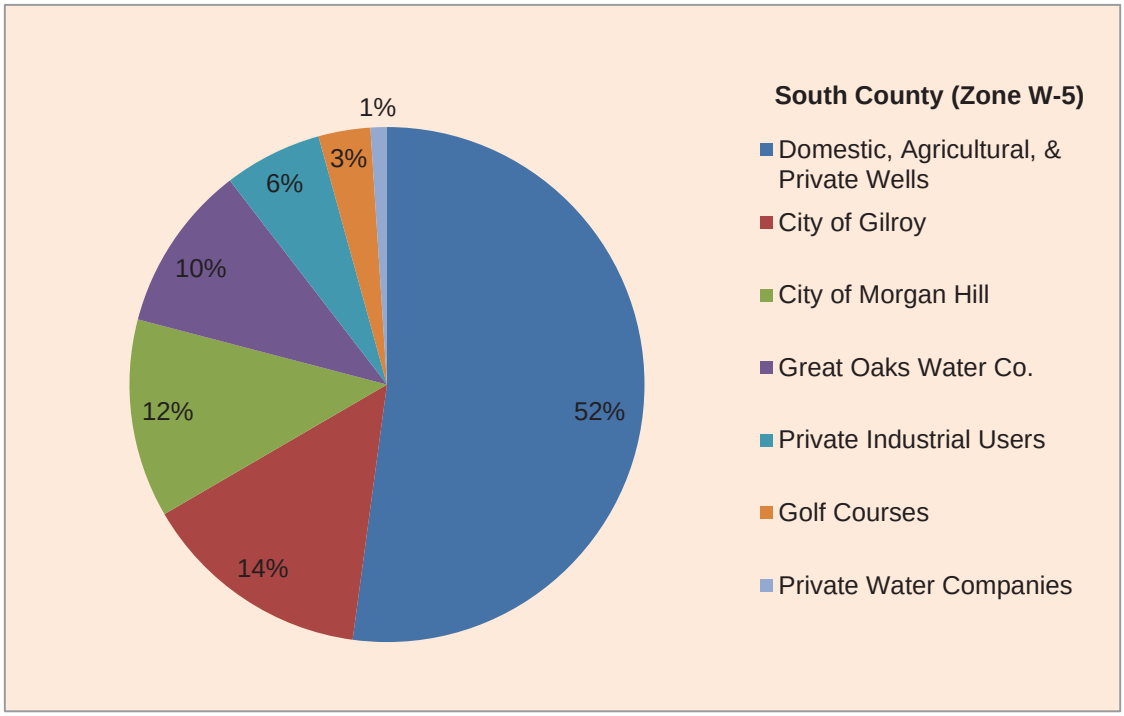


Figure 8. Percent of Total Pumping by Major Groundwater Users in 2018

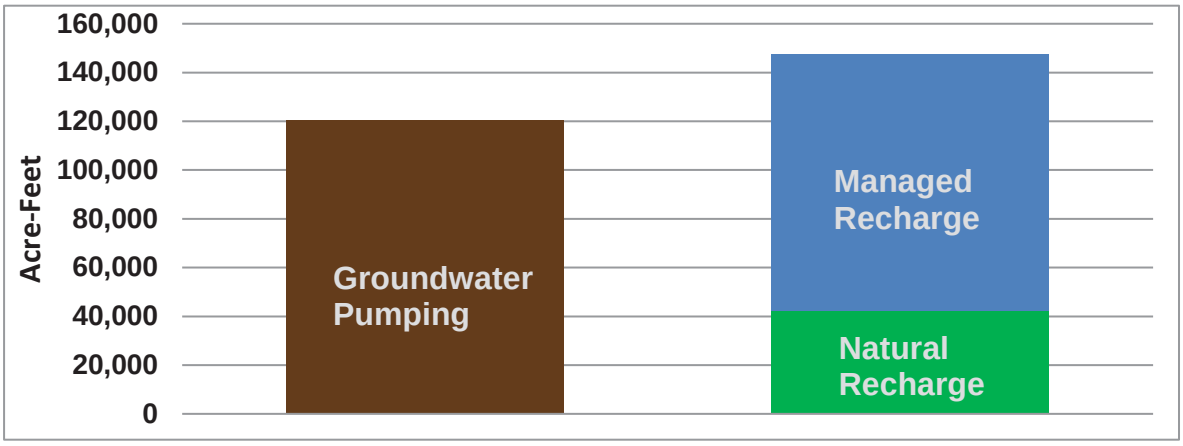




2.2 Groundwater Recharge

Since the 1930s, Valley Water's water supply strategy has been to maximize the conjunctive management of surface water and groundwater. Annual groundwater pumping far exceeds what is replenished naturally, so Valley Water relies on its managed recharge and in-lieu recharge activities to ensure water supply reliability. Total recharge exceeded groundwater pumping in 2018 (Figure 9) by a larger than normal margin due to below average pumping, above average rainfall, and the availability of surface water to fully operate the managed recharge program.

Figure 9. Countywide Groundwater Pumping and Recharge in CY 2018



Managed Recharge

Valley Water replenishes groundwater with imported water and surface runoff captured in 10 local reservoirs. Recharge facilities include more than 300 acres of recharge ponds and over 90 miles of creeks (Figure 10). Imported sources include the Federal Central Valley Project (CVP) and the State Water Project (SWP). The relative amounts of imported or local water used for managed recharge each year depend on many factors including hydrology, imported water allocations, treatment plant demands, and environmental needs. In general, a greater percentage of local water is used for recharge in wet years due to increased capture of local storm runoff in local reservoirs. Valley Water recharged 105,400 AF of local and imported surface water in 2018 (Table 4), above the long-term average of 96,000 AF. 65% of the managed recharge occurred in-stream, with the remainder through percolation ponds. Most water used for managed recharge came from local sources (52% in North County and 67% in South County); imported water contributed 44% to total managed recharge in CY 2018, as shown in Figure 11.

Table 4. CY 2018 Managed Recharge (AF)

Zone	In-Stream Recharge (Creeks)	Off-Stream Recharge (Recharge Ponds)	Total
W-2 (North County)	43,000	33,500	76,500
W-5 (South County)	25,700	3,200	28,900
Total	68,700	36,700	105,400

Figure 10. Valley Water Managed Recharge Facilities

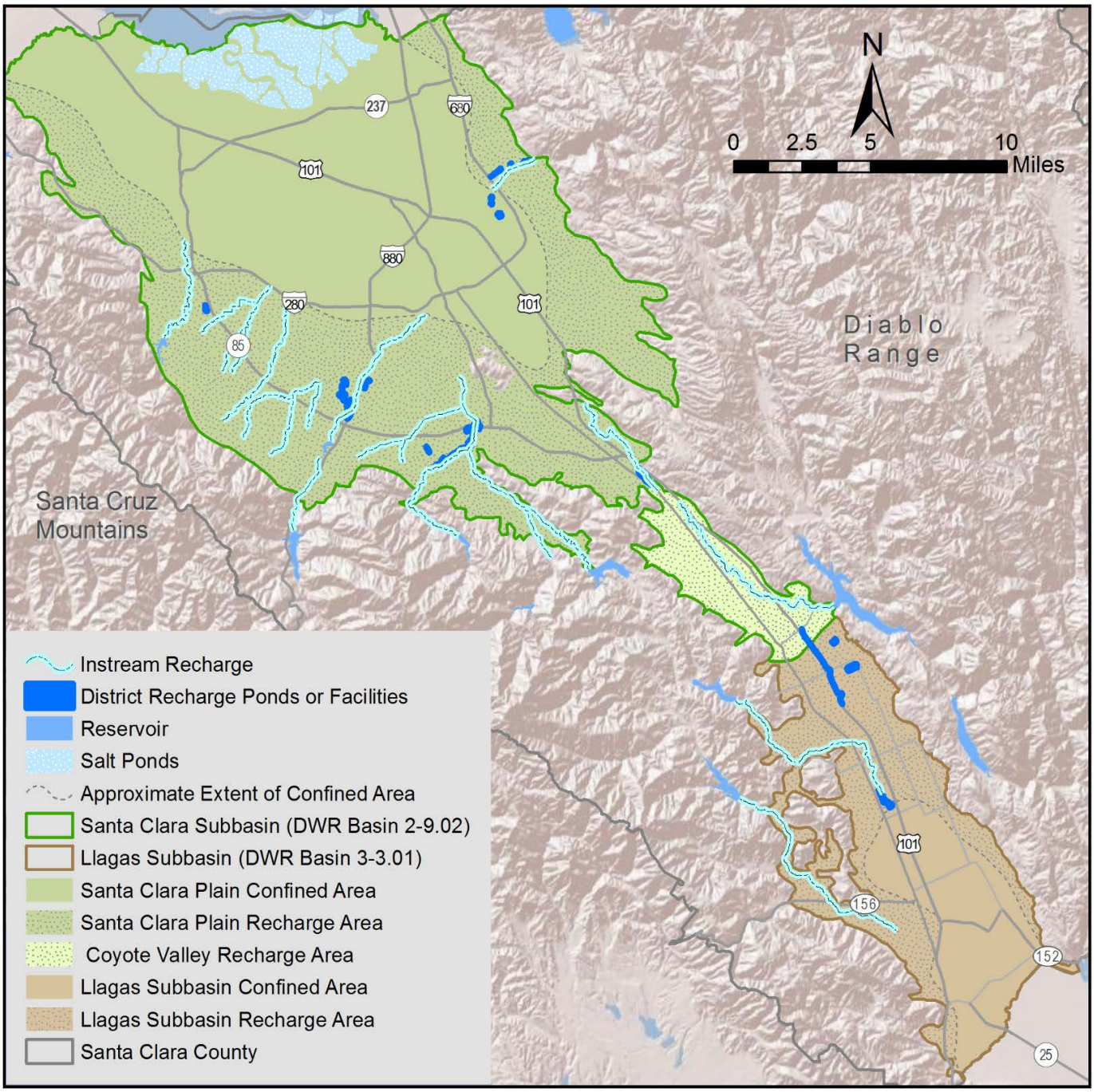
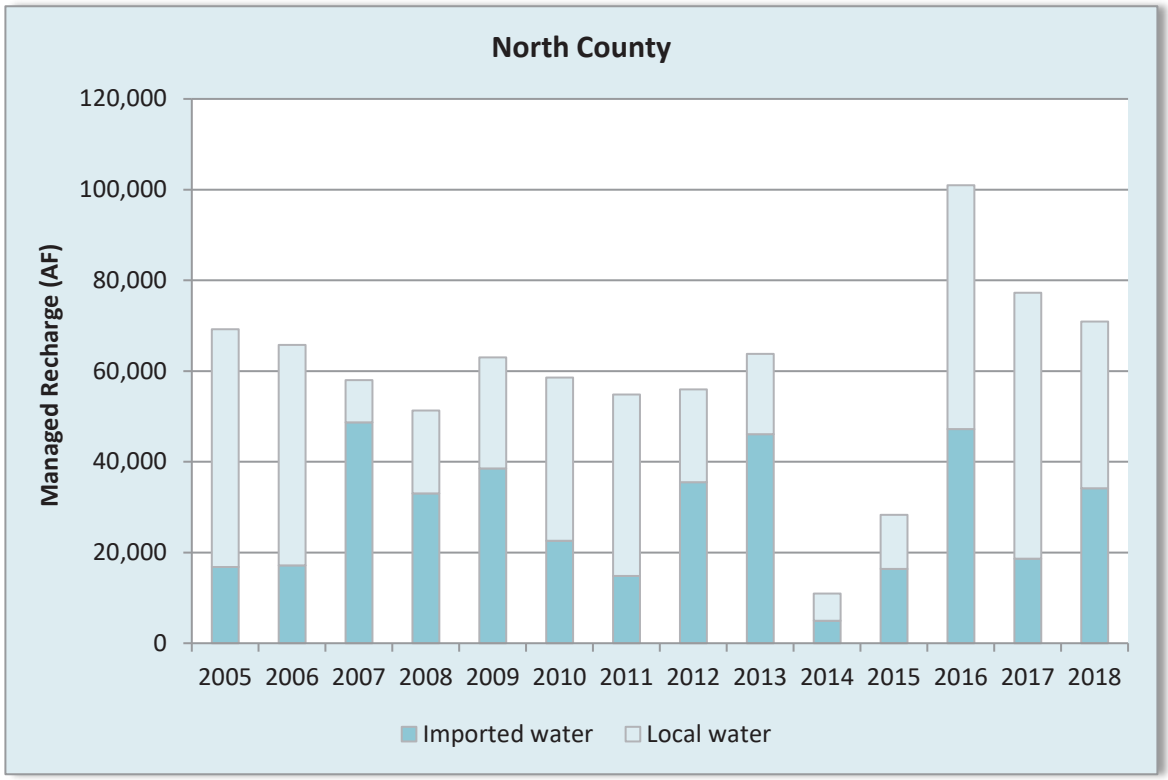
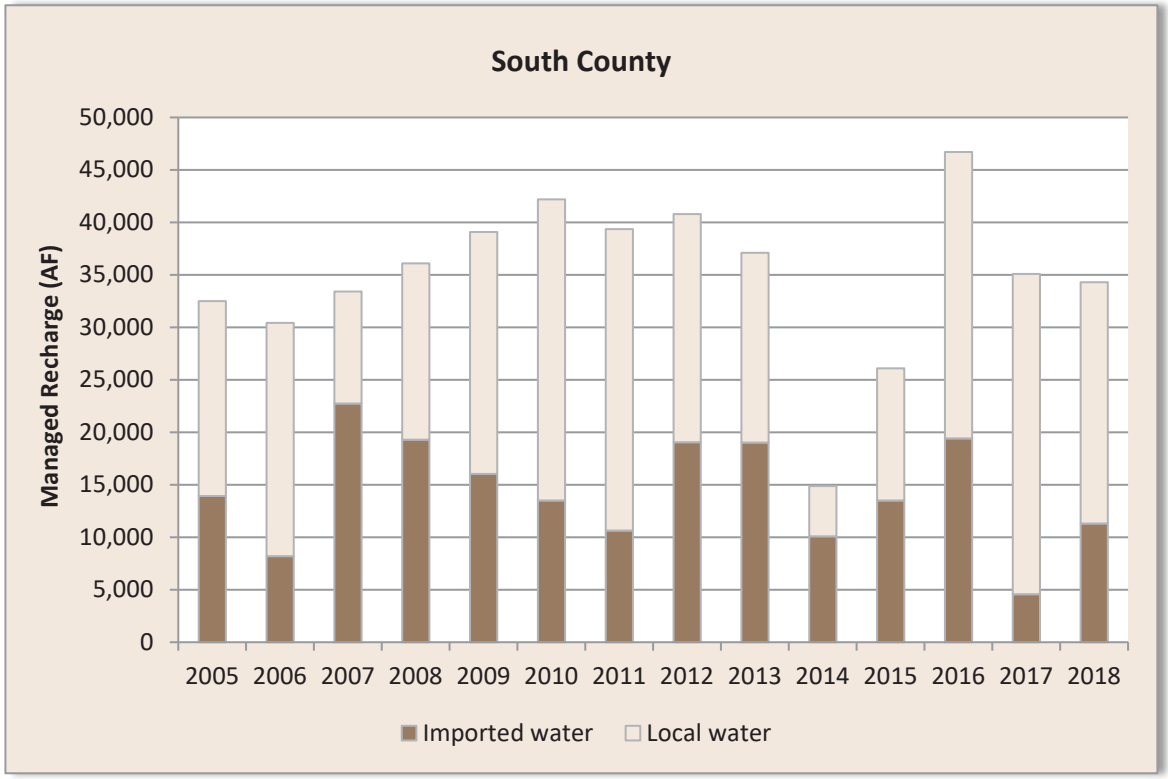


Figure 11. Managed Recharge by Source - North County and South County





Valley Water's 10 reservoirs were constructed in the 1930s and 1950s. Operating restrictions have been imposed on five of the reservoirs while seismic stability concerns are mitigated. These dam safety operating restrictions reduce the amount of water that can be stored for groundwater recharge by 45,000 AF but are needed to provide an adequate level of public safety. Moreover, an interim storage elevation restriction at Anderson Reservoir, the largest reservoir in the county, was approved by the California Division of Safety of Dams on May 8, 2017 following the Coyote Creek flooding of Presidents Day weekend of 2017. This elevation restriction translates into an additional loss of 10,000 AF in storage at Anderson Reservoir. In total, the restrictions result in a loss of about one third of the total surface storage capacity of Valley Water reservoirs. Current or upcoming Valley Water facility projects include seismic upgrades of Anderson, Calero, and Guadalupe dams, rehabilitation of Almaden Dam outlet works, replacement of Almaden Dam spillway, and rehabilitation of the Almaden-Calero Canal. The first phase of the seismic investigations of Coyote, Chesbro, and Uvas dams was concluded in 2019.

In-Lieu Recharge

Valley Water's treated water deliveries, water conservation, and recycled water programs play a critical role in maintaining groundwater storage by reducing the demand on groundwater. In 2018, treated water and recycled water provided 108,000 and 18,000 AF of water, respectively. Valley Water's long-term water conservation programs also saved approximately 77,300 AF.[12]

Valley Water's Silicon Valley Advanced Water Purification Center began operating in 2014. This state-of-the-art facility in San Jose produces up to 8 million gallons per day, or 9,000 AF per year, of highly purified water by treating recycled water with microfiltration, reverse osmosis, and ultraviolet light. This purified water is then blended with tertiary-treated recycled water to improve the quality for landscape irrigation and industrial uses. This facility supports Valley Water's goal of expanding the use of recycled and purified water, which reduces the demand on groundwater and increases supply reliability.

2.3 Groundwater Balance

While groundwater storage may increase or decrease each year, Valley Water's comprehensive managed and in-lieu recharge programs ensure long-term balance. The annual groundwater balance presented evaluates annual inflows and outflows for the Santa Clara Plain, Coyote Valley, and Llagas Subbasin, as shown in Figure 12. It should be noted that some terms presented in the groundwater balance cannot be directly measured and represent estimated values from Valley Water's calibrated groundwater flow models.

Inflows

Major inflows to the subbasins are primarily controlled by hydrologic conditions and include:

- Managed recharge by Valley Water, using local and imported surface water; and
- Natural recharge, which includes deep percolation of rainfall, natural seepage through creeks, subsurface inflow from adjacent aquifers, water loss from transmission and distribution lines, mountain front recharge, and return flows from septic systems and irrigation

[12] Santa Clara Valley Water District, Protection and Augmentation of Water Supplies, FY 2019-20 (PAWS), 48th Annual Report, February 2019.

Valley Water quantifies managed recharge using streamflow measurements and measured releases from reservoirs and raw water pipelines. Rainfall is measured at precipitation gage stations in San Jose (NOAA[13] Station USW00023293), Los Gatos (NOAA Station USC00045123), Coyote Valley (Valley Water Station 37), and Morgan Hill (Valley Water Station 41). These stations provide rainfall data used in each of Valley Water's three-calibrated numerical groundwater flow models (MODFLOW) for the Santa Clara Plain, Coyote Valley, and Llagas Subbasin. Subsurface inflows and outflows to and from adjacent aquifer systems and mountain front recharge are derived from Valley Water's calibrated groundwater flow models. Total inflows to all subbasins was 151, 400 AF in 2018, with managed Valley Water recharge providing 70% of total inflows.

Both locally and statewide, precipitation 2018 was a little below normal though there were several storm events characterized as "atmospheric rivers" that resulted in significant rainfall and surface water runoff. However, large storm events in a relatively short period of time do not provide the large amount of natural groundwater recharge one might expect due to high runoff and limited time for percolation. Estimated natural recharge in 2018 was 42,000 AF, approximately 25% less than in 2017.

Outflows

The primary outflow of groundwater is pumping, which accounted for 84% of the total outflow of 140,800 AF in 2018. Most groundwater pumped is metered. In Zone W-2, meters are required for wells pumping more than 1 AFY of non-agricultural water or 4 AFY of agricultural water annually. In Zone W-5, meters are required for wells producing more than 2 AFY of non-agricultural water or 20 AFY of agricultural water. Where meters are not installed, crop factors are used to determine agricultural water use, whereas domestic use is estimated from a table of average uses. Subsurface outflow to adjacent aquifer systems, creeks, storm and sewer systems, and plant uptake was 21,900 AF, or 16% of the total outflow.

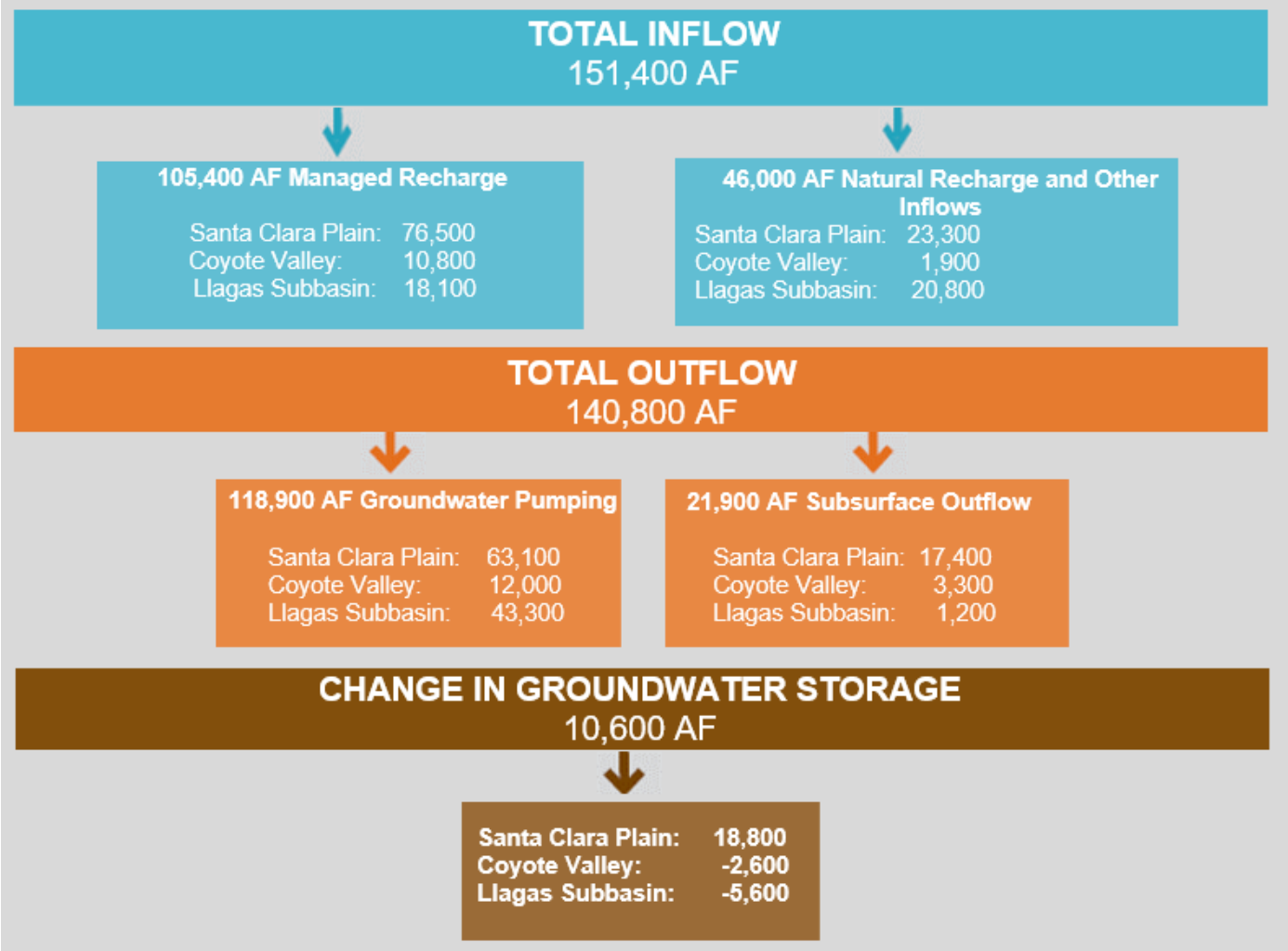
Change in Storage

There was an estimated increase in countywide storage of 10,600 AF in 2018 since the groundwater inflows exceeded the outflows. Compared to 2017, storage in the Santa Clara Plain increased by 18,800 AF while storage decreased by 2,600 AF and 5,600 AF for the Coyote Valley and Llagas Subbasin, respectively. This resulted in a total estimated storage of 352,500 AF, well within the "Normal" stage of Valley Water's Water Shortage Contingency Plan. Groundwater levels and storage are described in more detail in Chapter 3.

The remainder of this page is intentionally left blank

[13] U.S. Department of Commerce National Oceanic and Atmospheric Administration (NOAA).

Figure 12. CY 2018 Groundwater Balance



Notes:

1. Groundwater balance terms presented are estimates as of March 2019. These estimates are refined as additional data becomes available. Values shown are based on measured quantities or calibrated groundwater flow models, with all values rounded to the nearest 100 AF.
2. Managed recharge represents direct replenishment by Valley Water using local and imported water. Estimates from the groundwater models may differ slightly from surface water accounting estimates.
3. Natural recharge and other inflows include the deep percolation of rainfall, septic system and/or irrigation return flows, natural seepage through creeks, storm and sewer system seepage, and inflow from adjacent aquifer systems.
4. The groundwater pumping estimate is based on pumping metered by Valley Water or reported by low-volume groundwater users.
5. Subsurface outflow represents outflow to adjacent aquifer systems. In the Santa Clara Plain, this includes outflows to San Francisco Bay; in the Coyote Valley, this includes outflow to the Santa Clara Plain; and in the Llagas Subbasin, this includes outflows to the Bolsa Subbasin in San Benito County.

CHAPTER 3 – GROUNDWATER LEVELS AND STORAGE

Valley Water collected water level measurements from 222 wells in 2018 and evaluated water levels from an additional 115 wells measured by water retailers. After returning to pre-drought levels in 2017, groundwater levels throughout the county remained sustainable due to good water supply conditions and continued water use reductions. Countywide, customers served by water retailers achieved an impressive water use savings of 19% in 2018 compared to 2013, the pre-drought benchmark. Groundwater reserves increased by an estimated 10,600 AF during 2018 since total recharge exceeded pumping and other outflows. The estimated end of 2018 groundwater storage was 353,000 AF, which falls in the normal stage of Valley Water's Water Shortage Contingency Plan and is well above the GWMP storage target of 300,000 AF. The projected end of year storage for 2019 is also well above the 300,000 AF target.

3.1 Groundwater Levels

Comprehensive and accurate groundwater level data allows Valley Water to evaluate storage conditions and supports good operational decisions and water supply planning. Valley Water measured depth to water at 222 wells on a daily to monthly basis and evaluated data from 115 water retailer wells as shown in Figure 13. As the designated monitoring entity for Santa Clara County under the California Statewide Groundwater Elevation Monitoring (CASGEM) program, Valley Water uploaded over 1,200 groundwater elevation measurements for 106 wells to the CASGEM website in 2018.

Three groundwater level index wells are used to represent regional conditions in the Santa Clara Plain, the Coyote Valley, and the Llagas Subbasin (Figure 14). Table 5 shows March and October groundwater elevations for these index wells; these months typically represent the seasonal high and low groundwater elevations, respectively. The average groundwater elevation was 1.2 feet higher than the previous year in the Santa Clara Plain, 8.3 feet lower in the Coyote Valley, and 13.5 feet lower in the Llagas Subbasin. Groundwater elevations remained well above the historical minima and levels during the drought of 1987-1992 (Figure 14). Groundwater elevations were also well above the thresholds established to minimize the risk of land subsidence in all subsidence index wells throughout 2018.[14] All available groundwater elevation and depth-to-water data can be accessed on Valley Water's website at valleywater.org/groundwater.

The remainder of this page is intentionally left blank

[14] To avoid resumption of permanent subsidence, the District has established subsidence thresholds at ten index wells in the Santa Clara Plain as described further in Chapter 4.

Table 5. Groundwater Elevations at Regional Index Wells (feet, NGVD88)

Groundwater Subbasin/Area	Index Well	March 2018	October 2018	2018 Average	2017 Average	5 Year Average (2014-2018)	Period of Record Average
Santa Clara Subbasin, Santa Clara Plain	07S01W25L001	99.1	86.5	92.6	91.5	66.7	15.4
Santa Clara Subbasin, Coyote Valley	09S02E02J002	275.5	270.5	273.0	281.2	268.4	267.3
Llagas Subbasin	10S03E13D003	236.6	209.3	223.6	237.1	210.5	220.6

Note: The period of record for the index wells is 1936-2018 for the Santa Clara Plain, 1948-2018 for the Coyote Valley, and 1969-2018 for the Llagas Subbasin.

Groundwater elevation contours for the principal aquifer zone in spring and fall of 2018 are shown in Figures 15 and 16. The spring and fall maps were created using the water level measurements closest to March 31, 2018 and September 30, 2018, respectively. The typical seasonal pattern observed is that groundwater levels peak in the spring and decline through the summer and fall due to increased pumping and less natural recharge. While this pattern is visible in Figures 15 and 16, the change is not as pronounced as some past years due to reduced pumping by major retailers.

In the Santa Clara Subbasin, the general groundwater flow direction is northwest from the Coyote Valley toward San Francisco Bay. Valley Water's managed recharge program helps maintain adequate pressures in the principal aquifer zone such that groundwater flows toward the bay and maintains an upward vertical gradient near the bay. The upward gradient minimizes the potential for saltwater intrusion into the principal aquifers. Artesian conditions occur in the confined area of the Santa Clara Plain and, in 2018, an increasing number of wells had groundwater with substantial artesian pressure.

The 2018 groundwater flow patterns observed in South County were similar to those observed in the past. In Coyote Valley, the highest elevations are at the subbasin divide near Cochrane Road and groundwater generally flows toward the northwest. The highest groundwater elevations in the Llagas Subbasin are in the recharge area in Morgan Hill, and groundwater generally flows southeast toward the Pajaro River and San Benito County. Managed and natural recharge within the recharge area maintains groundwater pressures within the southern confined area, where deeper groundwater occurs in partially to fully confined (artesian) conditions. Similar to the Santa Clara Plain, artesian pressures increased in some wells in 2018.

Figure 13. CY 2018 Groundwater Level Monitoring

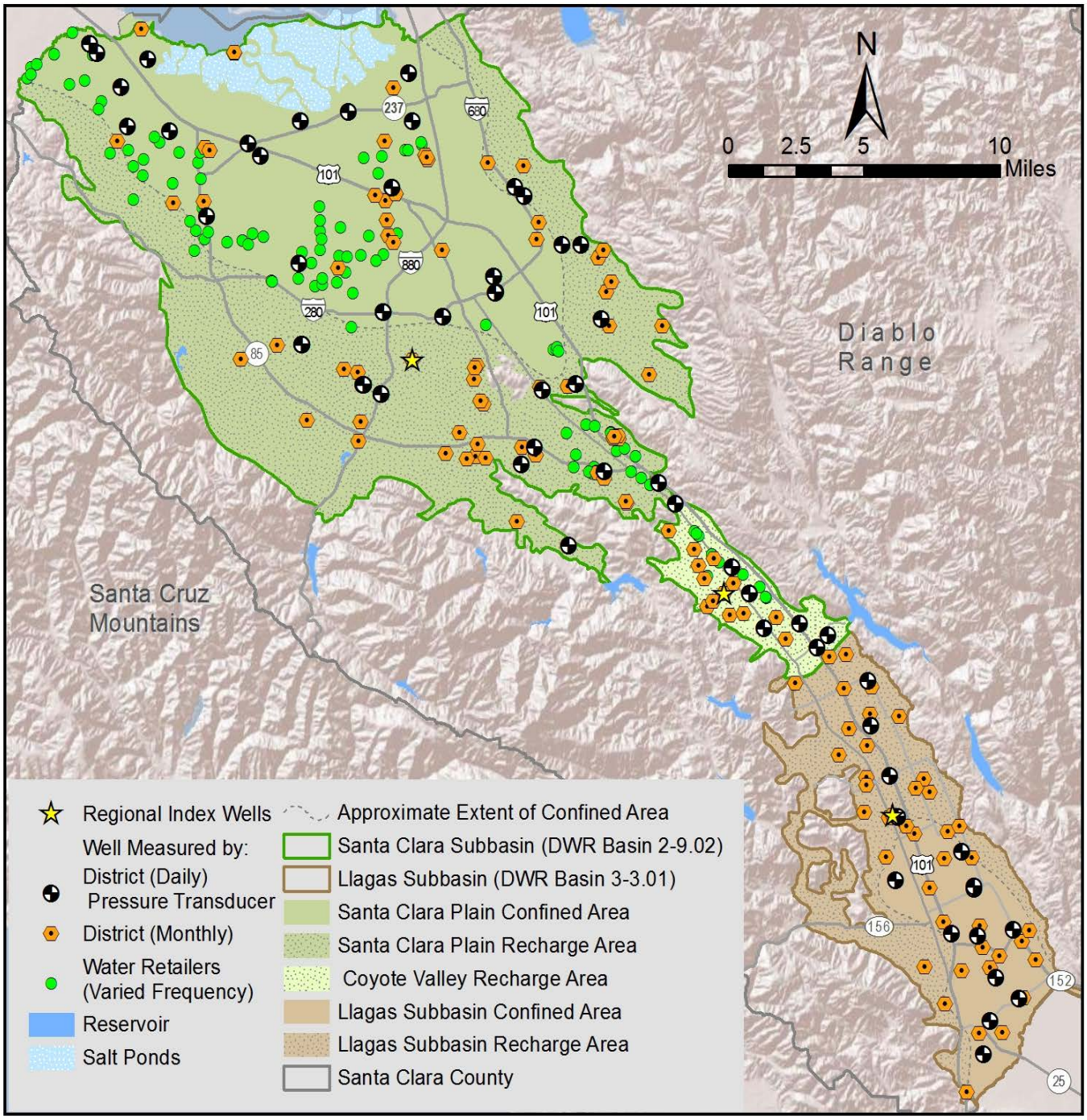


Figure 14. Groundwater Elevations at Regional Index Wells

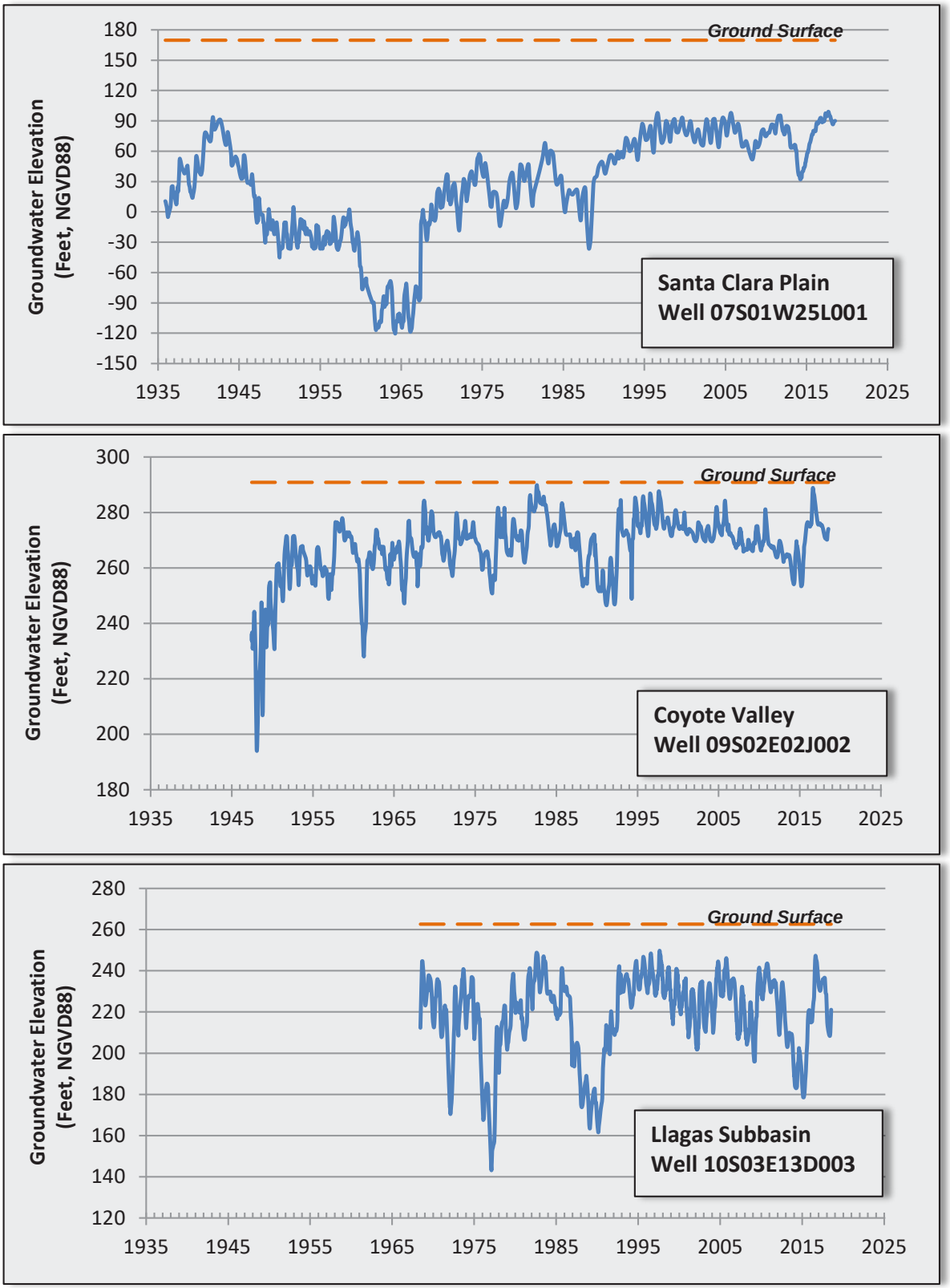


Figure 15. Spring 2018 Groundwater Elevation Contours in the Principal Aquifer

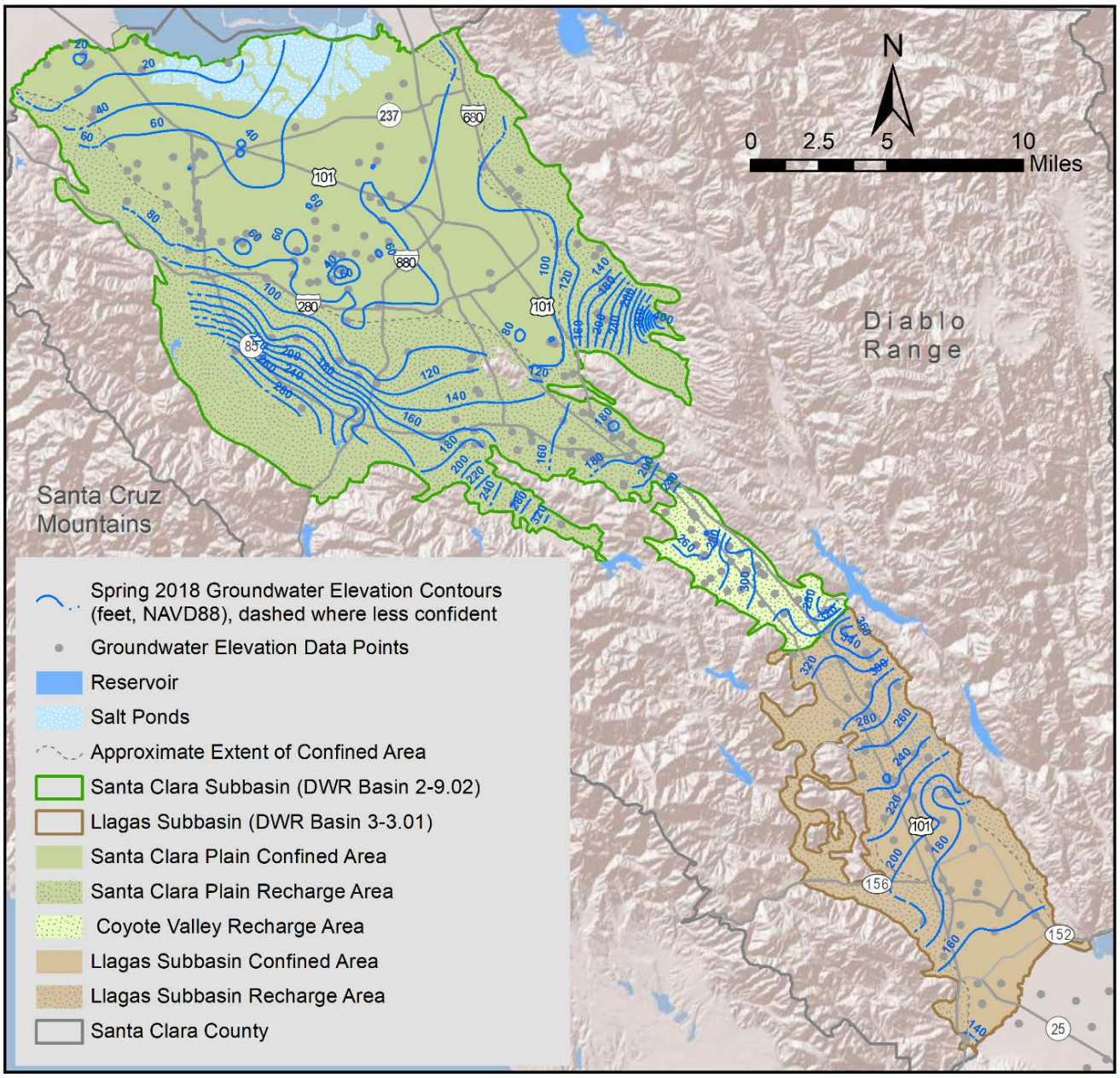
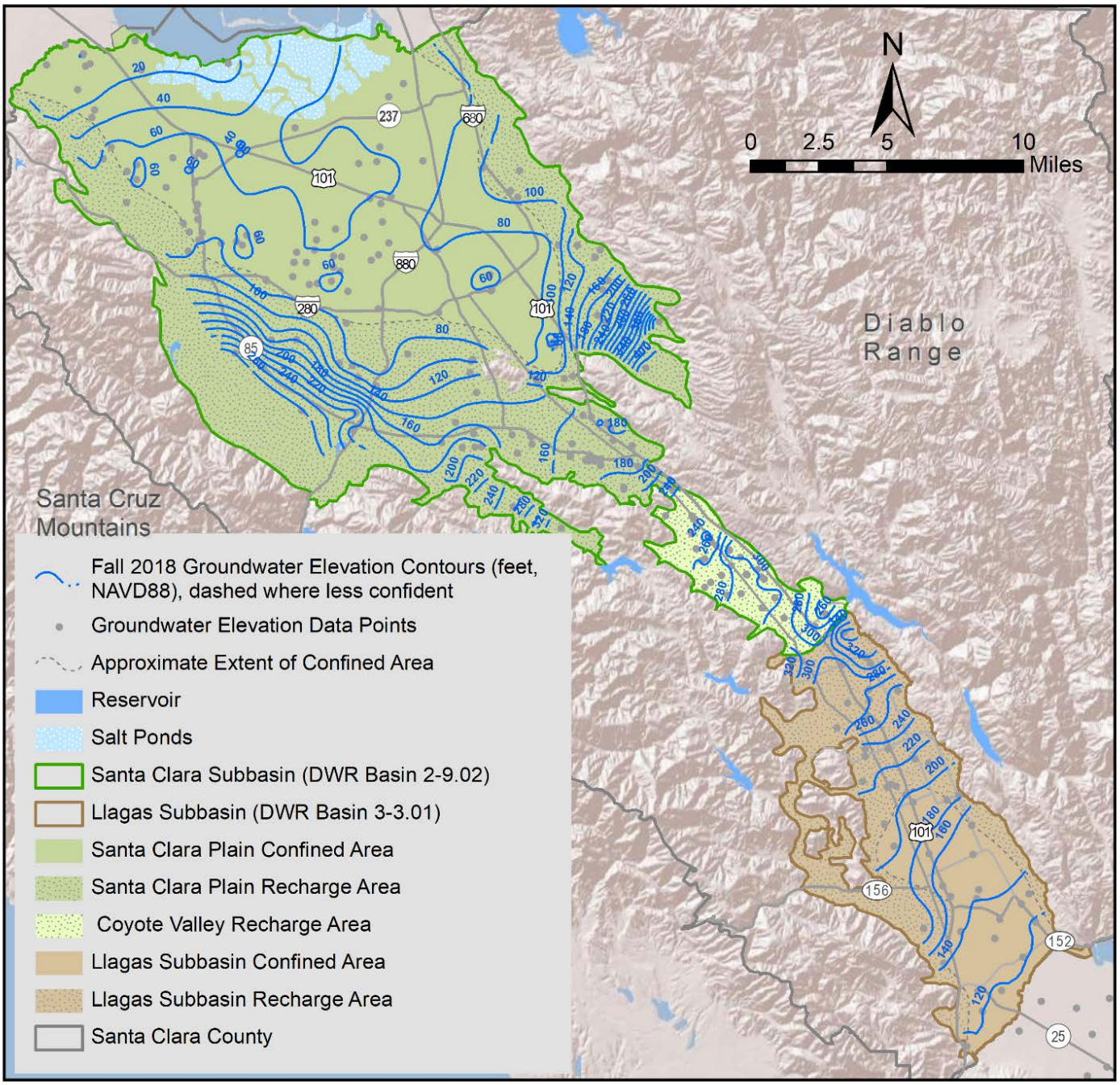


Figure 16. Fall 2018 Groundwater Elevation Contours in the Principal Aquifer



3.2 Groundwater Storage

Estimated countywide groundwater storage at the end of 2018 was 352,500 AF; this is well above the GWMP outcome measure of 300,000 AF, and 10,600 AF higher than 2017 (Table 6). End of year groundwater storage of more than 300,000 AF falls within the normal stage (Stage 1) of Valley Water's Water Shortage Contingency Plan, indicating good water supply conditions. The end of year storage for 2019 is projected to be well above the 300,000 AF target.

Table 6. Estimated End of Year Groundwater Storage (AF)

Groundwater Subbasin/Area	GWWP Outcome Measure	End of Year 2017	End of Year 2018	Change in Storage
Santa Clara Subbasin Santa Clara Plain	278,000	305,400	324,200	+18,800
Santa Clara Subbasin Coyote Valley	5,000	10,200	7,600	-2,600
Llagas Subbasin	17,000	26,300	20,700	-5,600
Total	**300,000**	**341,900**	**352,500**	**+10,600**

Note: Groundwater storage estimates presented are as of December 2018. These estimates are based on accumulated groundwater storage since 1970, 1991, and 1990 for the Santa Clara Plain, Coyote Valley, and Llagas Subbasin, respectively. These estimates are refined as additional pumping and managed recharge data become available.

Groundwater Storage Outcome Measures

Valley Water met each of the three outcome measures in 2018 as shown below.

OM 2.1.1.a.: Greater than 278,000 AF of projected end of year groundwater storage in the Santa Clara Plain.
Outcome met: End of 2018 storage for the Santa Clara Plain is estimated to be 324,200 AF.

OM 2.1.1.b.: Greater than 5,000 AF of projected end of year groundwater storage in the Coyote Valley.
Outcome met: End of 2018 storage for the Coyote Valley is estimated to be 7,600 AF.

OM 2.1.1.c.: Greater than 17,000 AF of projected end of year groundwater storage in the Llagas Subbasin.
Outcome met: End of 2018 storage for the Llagas Subbasin is estimated to be 20,700 AF.

CHAPTER 4 – LAND SUBSIDENCE

Subsidence is a concern due to historical occurrence in the Santa Clara Plain and because it can lead to an increased risk of flooding, saltwater intrusion into groundwater, and damage settlement-sensitive infrastructure and utilities. In 2018, Valley Water monitored for subsidence at 141 benchmarks along three cross valley land surface level circuits and at two extensometers in the Santa Clara Plain. Groundwater levels at ten subsidence index wells were also monitored and compared to thresholds established at each well to minimize the risk of permanent land subsidence. The subsidence outcome measure was met in 2018 with subsidence below than the threshold of 0.01 feet per year. In fact, net uplift was noted in 2018 in the Santa Clara Plain, indicating very good conditions. Subsidence has never been observed in the Coyote Valley or the Llagas Subbasin, so there is no related outcome measure in those areas.

Between 1915 and 1969, land subsidence occurred in the Santa Clara Plain due to groundwater overdraft, with 13 feet of inelastic (permanent) land subsidence occurred in San Jose. Inelastic subsidence was essentially halted by about 1970 through Valley Water's expanded conjunctive water management programs, which facilitated the return of groundwater to levels well above subsidence thresholds. Elastic (non-permanent) subsidence and recovery occurs annually in response to seasonal pumping and recharge as indicated by satellite studies and extensometer measurements (Appendix A).[15] To avoid resumption of inelastic subsidence, Valley Water has established subsidence thresholds at ten index wells in the Santa Clara Plain.[16] A tolerable rate of 0.01 feet per year of subsidence was used to determine thresholds at these wells.[17] These subsidence thresholds are the groundwater levels above which groundwater must be maintained to ensure a low risk of land subsidence.

Valley Water conducts ongoing monitoring of land surface benchmarks, extensometers, and groundwater levels at subsidence index wells to determine if land subsidence is occurring and threatening to exceed established thresholds. Subsidence monitoring points are shown in Figure 17. Recent monitoring data from extensometers, benchmark surveys, and subsidence index wells indicates that there is low risk of subsidence, as described further below and in the 2018 Subsidence Data Analysis Technical Memorandum (Appendix A).

4.1 Extensometer Monitoring

Valley Water monitors two 1,000-foot deep extensometers that measure aquifer compaction by comparing vertical ground elevation relative to a central, isolated pipe set beneath the water-bearing units. The extensometers, located in Sunnyvale near Moffett Field ("Sunny") and near downtown San Jose ("Martha"), are equipped with data loggers to provide hourly aquifer compaction and water level readings. Valley Water evaluates the average land subsidence measured during the last 11 years to determine if it meets the tolerable rate of land subsidence of 0.01 feet/year.

Figure 18 shows cumulative compaction measured at the extensometers for the period of record supplemented with nearby benchmark data. These figures show that land subsidence over the last few decades has been negligible. The figures also show close correlation between Valley Water's land subsidence model output and actual measured data. Measured data show a negative compaction (i.e., aquifer expansion) at both the Sunny and Martha sites in 2018. The average subsidence rate over the last 11 years (2008 to 2018) is -0.004 feet/year, which is

[15] Schmidt, D. A., and R. Bürgmann, 2003, Time-dependent land uplift and subsidence in the Santa Clara valley, California, from a large interferometric synthetic aperture radar data set, *J. Geophysical Res., 108* (B9), 2003.
[16] Geoscience Support Services Inc. for Santa Clara Valley Water District, Subsidence Thresholds in the North County Area of Santa Clara Valley, 1991.
[17] The tolerable subsidence rate of no more than 0.01 feet per year on average was endorsed by Valley Water's Water Retailer

below the tolerable subsidence rate of 0.01 feet/year. The average for the previous period (2007 to 2017) was 0.001 feet/year. The decreased average subsidence rate results from continued groundwater level recovery from 2016 to 2018 following the recent drought. Measured compaction is within the elastic range observed historically, but Valley Water will continue to closely monitor land subsidence conditions.

4.2 Benchmark Elevation Surveys

Periodic benchmark surveys of land surface elevation have been conducted in Santa Clara County since 1912.[18] Valley Water's current benchmark leveling program consists of annual surveys along three cross valley level circuits in the Santa Clara Plain (Figure 17). In 2018, Valley Water analyzed land surface elevation data from 141 benchmarks to evaluate the spatial variability of land subsidence. Survey data at most benchmarks show the land surface rising in 2018, with an average uplift of 0.01 feet along the three circuits. This uplift is due to annual recharge exceeding pumping. Regional benchmark survey data is consistent with extensometer data by also indicating the average annual drop of land surface over the last 11 years does not exceed the tolerable rate of subsidence of 0.01 feet per year.

4.3 Subsidence Index Wells

Groundwater level measurements are an integral part of land subsidence monitoring because declining water levels due to long-term overdraft were the driving force of historical subsidence in the Santa Clara Plain. Valley Water measures water levels at ten subsidence index wells on a daily to monthly basis to determine if water levels are nearing established subsidence thresholds. If water levels stay near to or drop below subsidence thresholds for extended periods, permanent land subsidence may resume, resulting in an increased risk of flooding, salt water intrusion, and damage to infrastructure and utilities.

Figure 19 shows groundwater levels and subsidence thresholds at the ten subsidence index wells. The lowest historical water levels were generally observed in the 1960s and 1970s. Since then, groundwater levels have recovered, primarily due to Valley Water's managed recharge and in-lieu recharge programs. Similar to the regional groundwater elevation index wells, 2018 average water levels are close to or at historic highs in all subsidence index wells, indicating a full recovery of the groundwater resource since the drought. Three subsidence index wells located near the Baylands continue to have upward vertical gradients. In addition to keeping water levels above subsidence thresholds, maintaining an upward hydraulic gradient in the principal aquifer zone is critical for preventing shallow groundwater with elevated salts from entering the principal aquifer through abandoned wells and other vertical conduits. Valley Water will continue to frequently track data from the subsidence index wells to support water supply operations and planning.

[18] USGS, Land Subsidence in the Santa Clara Valley, California as of 1982, Professional Paper 497-F, 1988.

Figure 17. CY 2018 Land Subsidence Monitoring

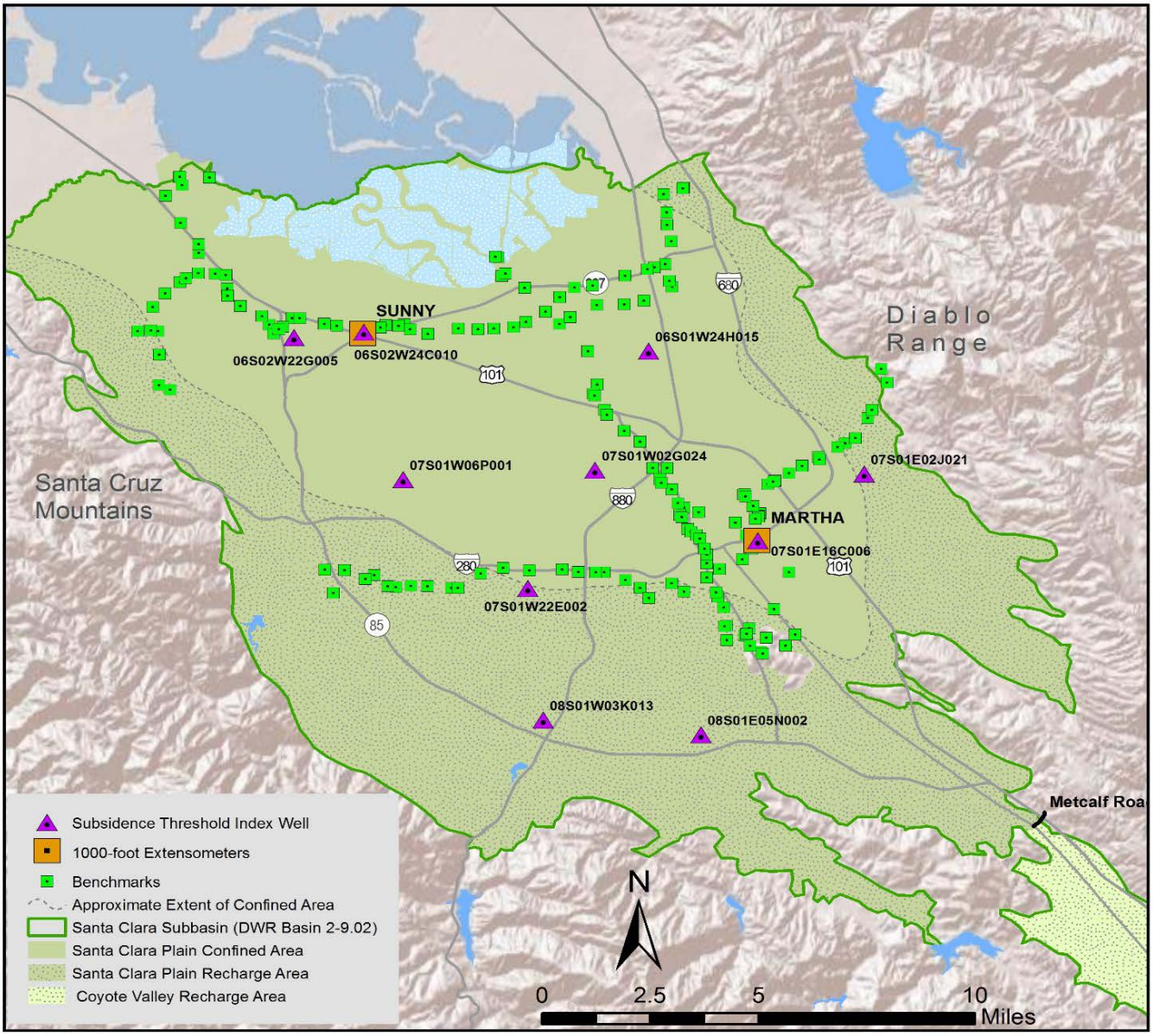
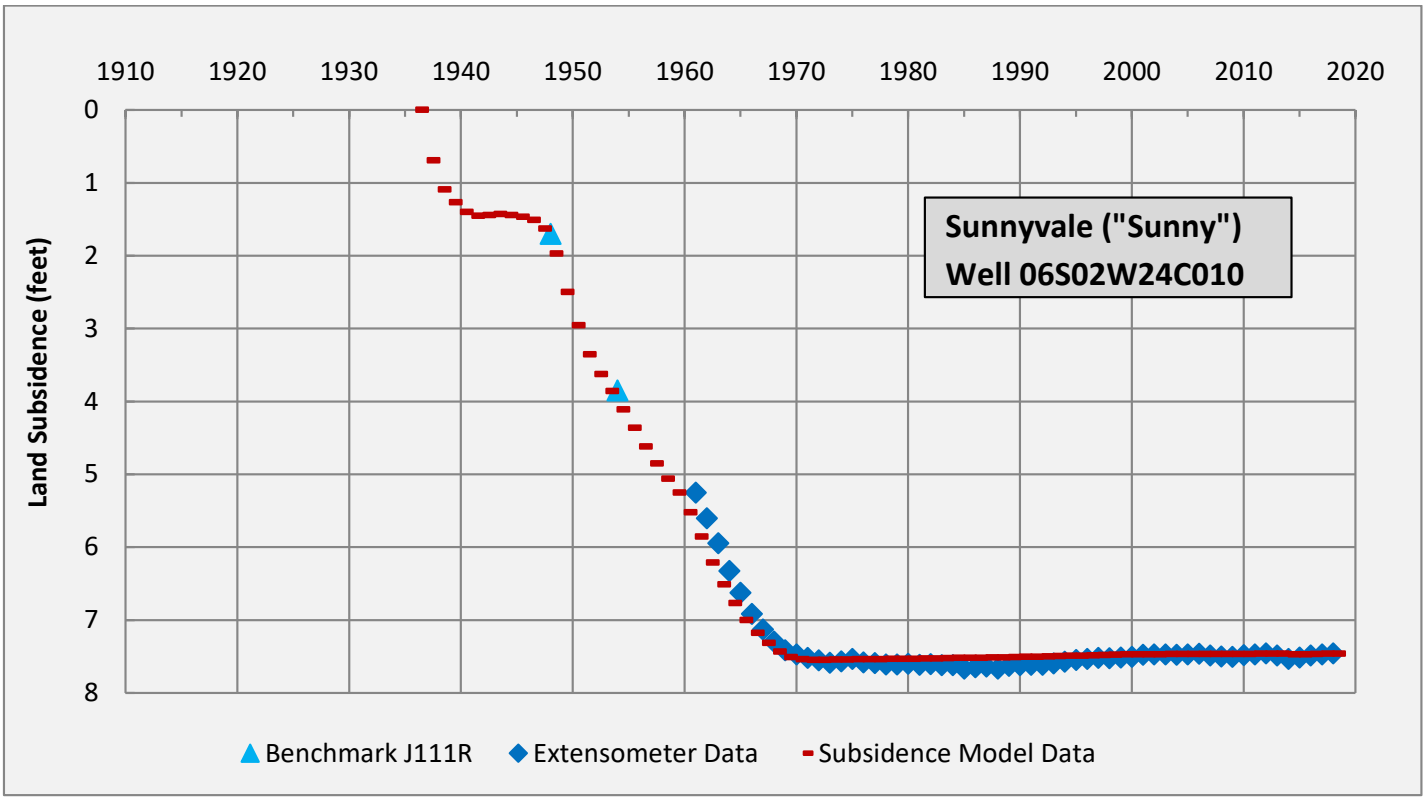


Figure 18. Cumulative Land Subsidence



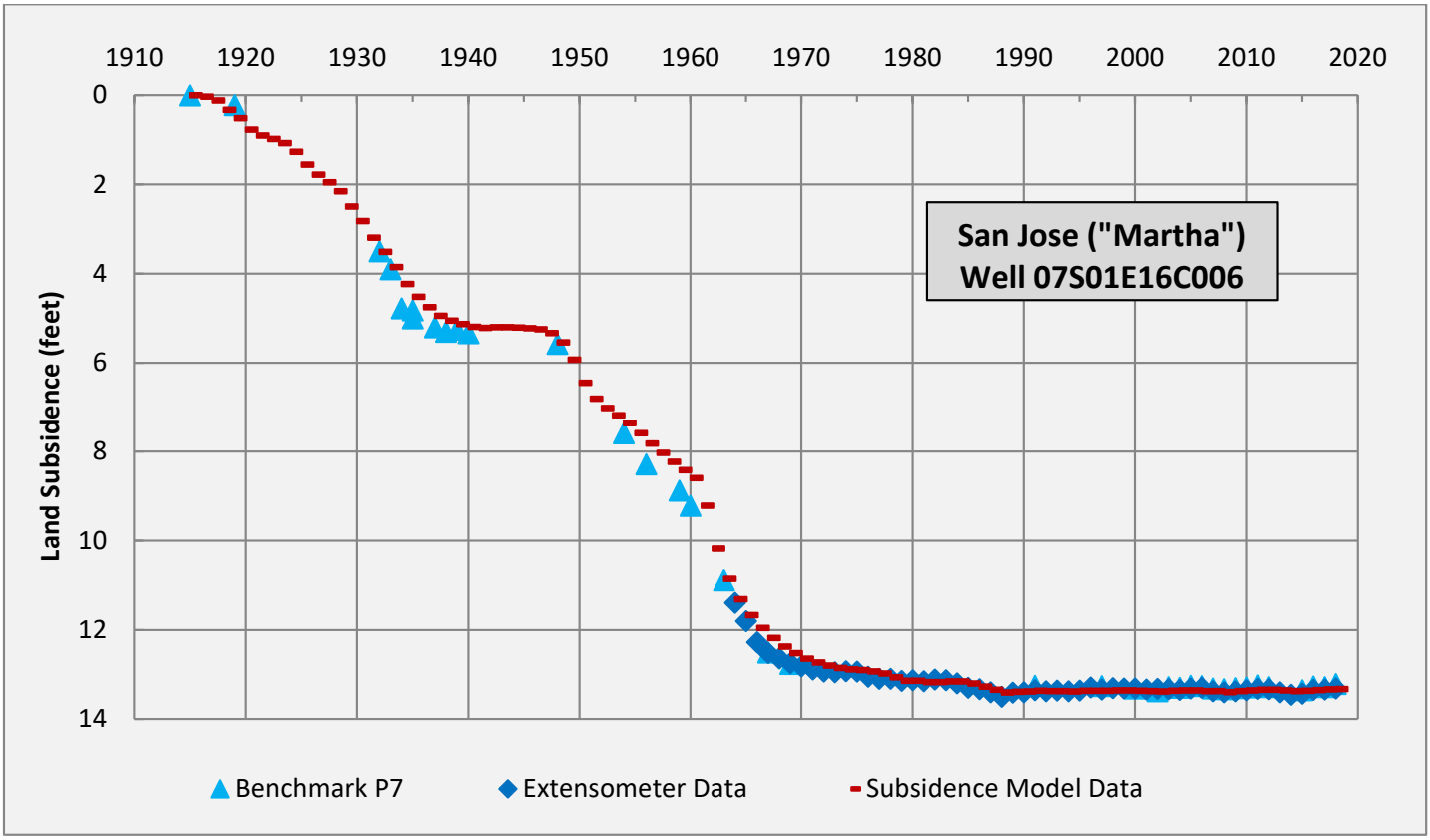
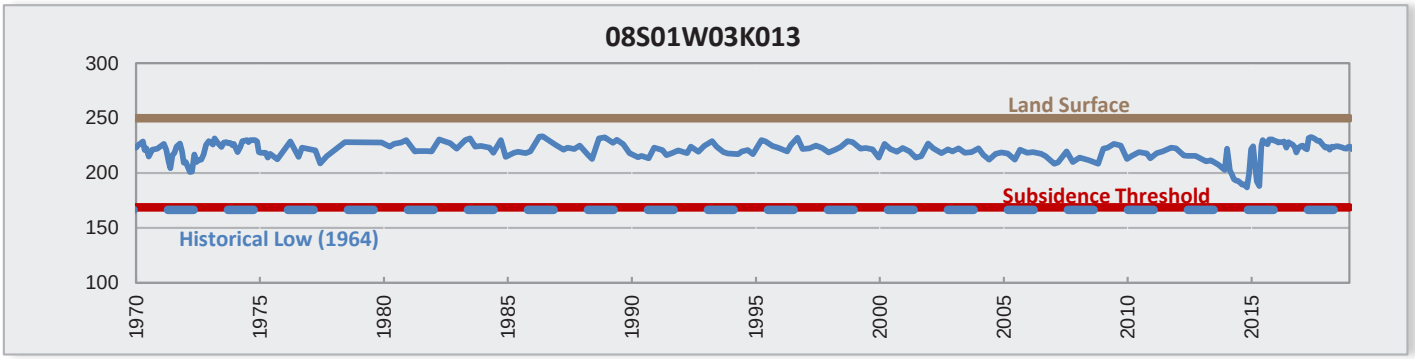
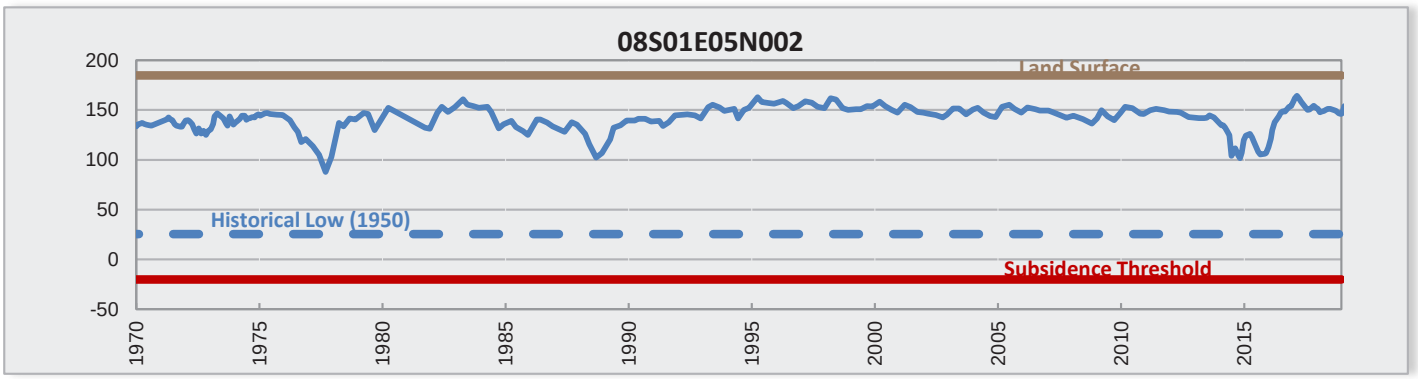
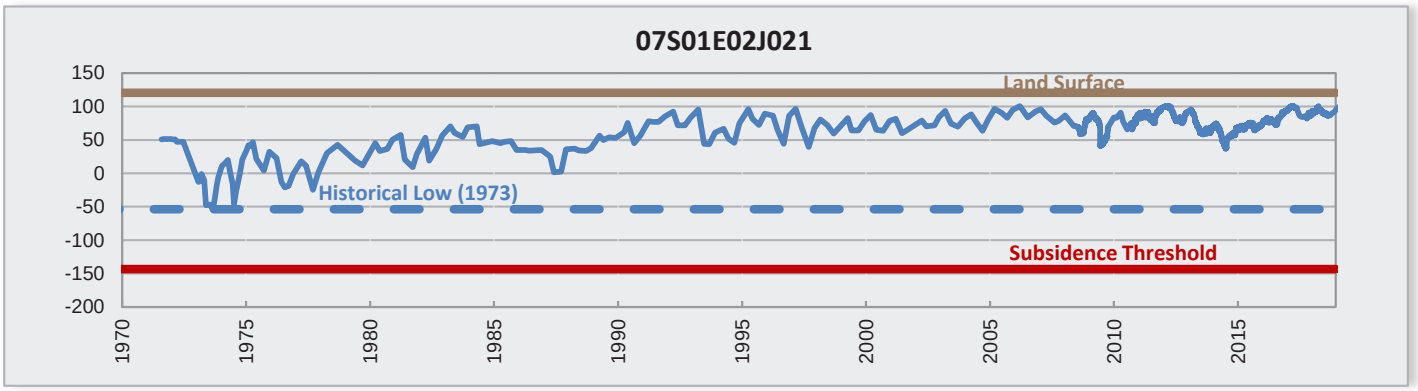


Figure 19. Groundwater Levels at Santa Clara Plain Subsidence Index Wells (feet, NAVD88)







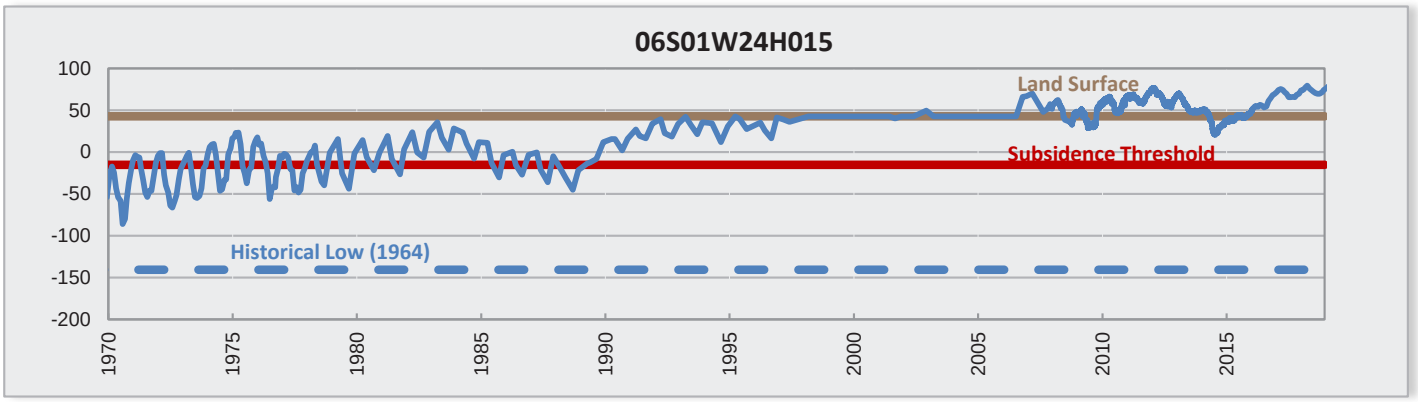
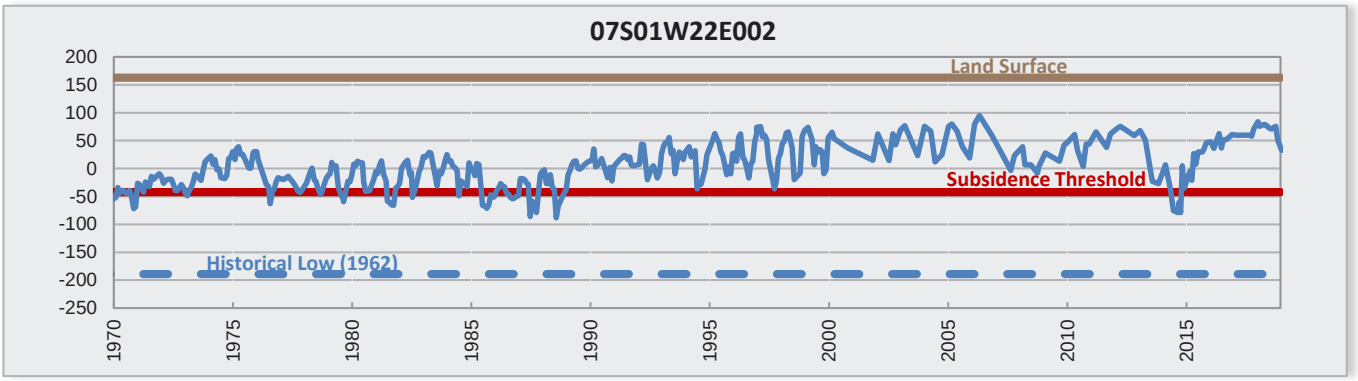
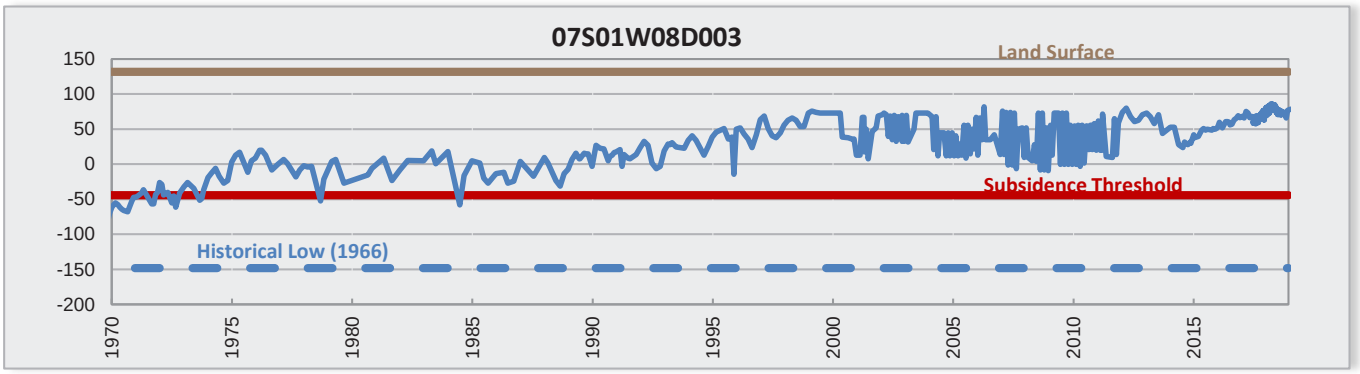
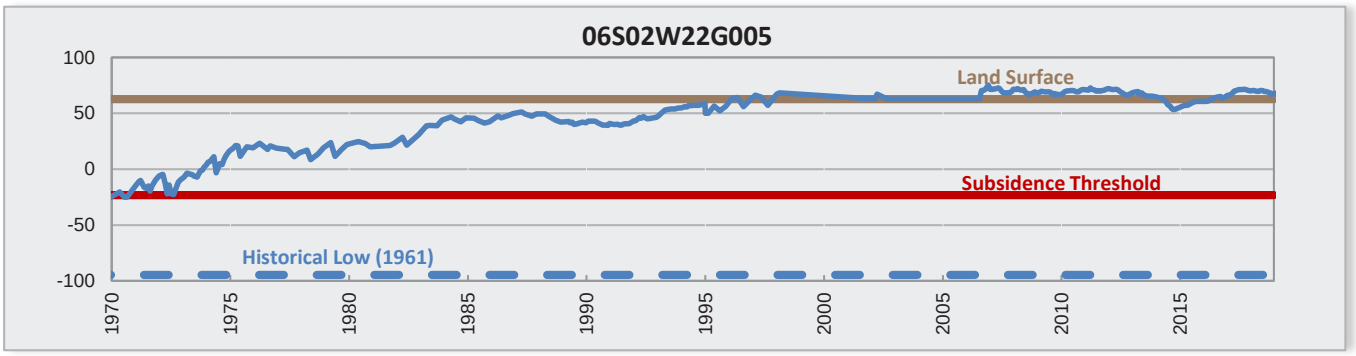


Figure 19. Groundwater Levels at Santa Clara Plain Subsidence Index Wells (feet, NAVD88 continued)







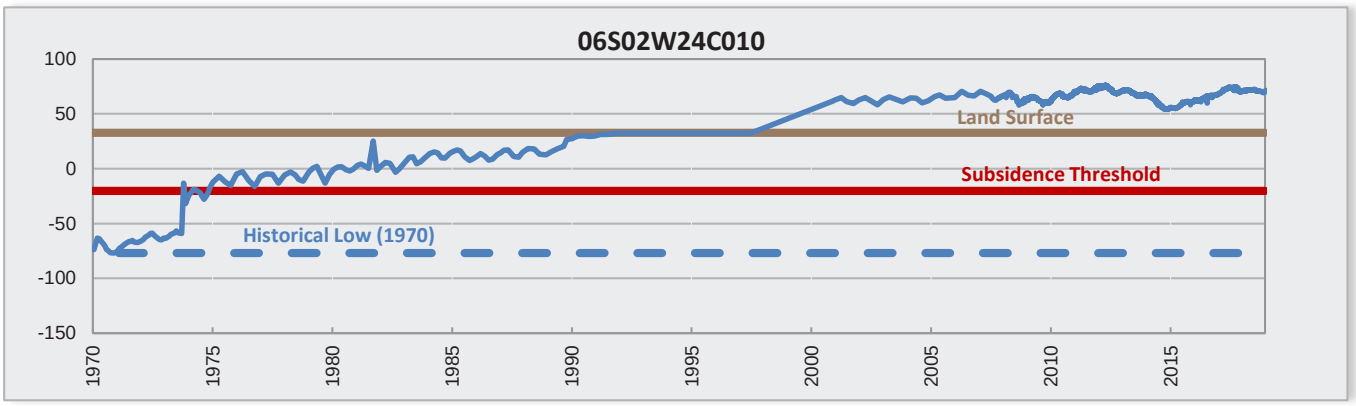
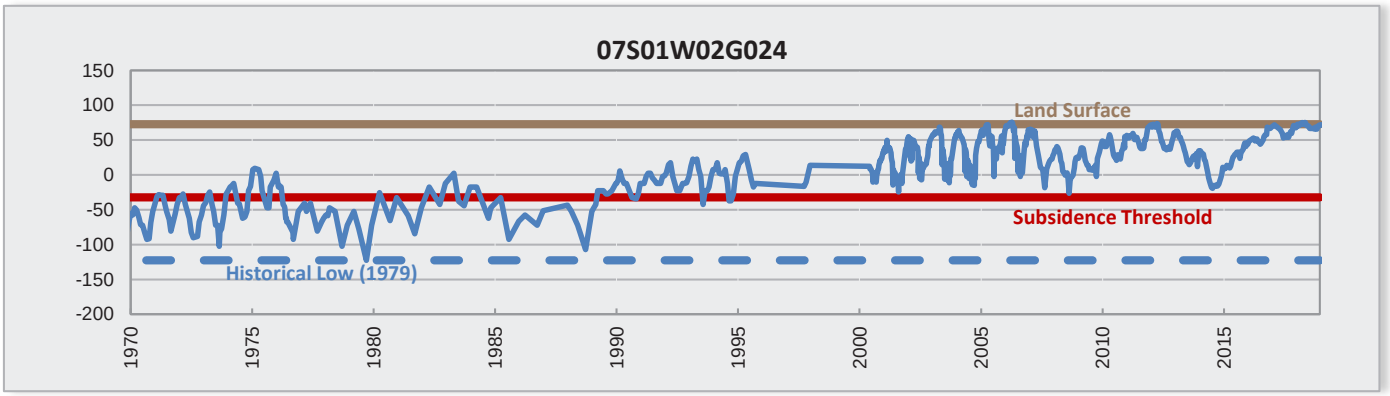
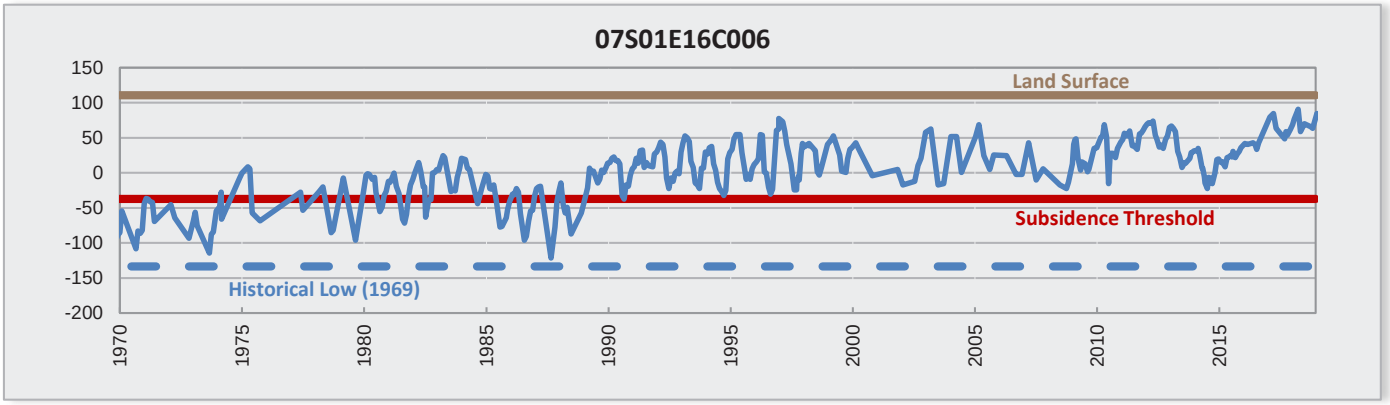


Figure 19. Groundwater Levels at Santa Clara Plain Subsidence Index Wells (feet, NAVD88 continued)





Land Subsidence Outcome Measure

As shown in Figure 19 and described in this chapter, Valley Water's land subsidence outcome measure was met in 2018.

OM 2.1.1.d.

100% of subsidence index wells with groundwater levels above subsidence thresholds.
This outcome measure was met. Groundwater levels were above subsidence thresholds at all ten Santa Clara Plain subsidence index wells.

CHAPTER 5 – GROUNDWATER QUALITY

In 2018, Valley Water collected groundwater samples from 341 wells and analyzed the water quality. This included 85 wells that are sampled each year (dedicated monitoring wells and domestic wells), 231 domestic wells tested through a voluntary program, and 25 wells near recycled water irrigation sites. Valley Water also analyzed groundwater quality data from 249 public water supply wells.[19] A summary of 2018 groundwater quality results for water supply wells is presented in Appendix B. Summary tables of analyzed parameters with the median and range for each subbasin and aquifer zone[20] for all regional wells sampled are provided in Appendix C.

Water quality testing indicates that groundwater in the Santa Clara and Llagas Subbasins meets drinking water standards in most wells for all parameters tested. The exception is nitrate, which was found above regulatory standards in 23% of South County water supply wells sampled (primarily domestic wells) due to current and historic sources. The implementation of Salt and Nutrient Management Plan[21] supports reduced nitrate loading and exposure. Valley Water also offers eligible domestic well owners free water testing for nitrate, as well as rebates of up to $500 for qualifying nitrate treatment systems.

During 2018, Valley Water conducted limited sampling of the Lower and Upper Llagas Recharge Systems. In general, water from Uvas Creek (Lower Llagas Recharge System) has a calcium-magnesium bicarbonate character, is low in nitrate and TDS, and lacks chemical impurities, providing good water quality for recharge into the Llagas Subbasin. The Upper Llagas Recharge System (Main Avenue and San Pedro Ponds) is supplied with raw imported water at most times. Although raw water supplied to this site may contain higher levels of chloride and sodium than ambient groundwater, no parameters were detected above drinking water standards in any recharge water samples collected in 2018 or since 2006. The results of the 2018 sampling are summarized in Section 5.4 below and related tables are presented in Appendix D.

At wells near recycled water irrigation sites, per- and polyfluoroalkyl substances (PFAS)[22] were detected in some shallow wells (not used for drinking water) while N-Nitrosodimethylamine (NDMA) was not detected in any wells during 2018. These compounds are considered potential wastewater indicators, although there are other potential sources. NDMA and PFAS have historically been detected in some shallow groundwater near recycled water use sites. Groundwater near recycled irrigation sites demonstrates a mix of stable, decreasing, and increasing concentration trends for key water quality indicators. Altered water quality that appears related to recycled water use is apparent at some sites in both the Santa Clara and Llagas Subbasins. Although not used for drinking, the presence of PFAS in several monitoring wells above recently established DDW drinking water notification levels warrants further evaluation.

Due to the widespread use of PFAS in industrial and consumer products, DDW is mandating testing of various public water systems to better understand the occurrence of PFAS in drinking water. Valley Water will continue to work with the state and with local water retailers to better understand the presence and potential sources of PFAS in local water supplies and to take action if needed to ensure a safe and reliable drinking water supply. To support this, Valley Water is exploring additional monitoring and our water quality laboratory is preparing to obtain state certification to test for PFAS in drinking water.

---

[19] Data for public water systems is available from the State Water Resources Control Board Division of Drinking Water website.
[20] Public water supply wells were assumed to represent the principal aquifer is no construction information was available, as these are typically deep wells.
[21] https://www.valleywater.org/your-water/where-your-water-comes-from/groundwater/groundwater-studies
[22] These substances include PFOA and PFOS and are sometimes referred to as “Perfluorinated chemicals” or PFCs.

Valley Water continues to coordinate with local, state, and federal agencies managing cleanup of groundwater contamination sites by tracking progress on high-priority sites and issuing recommendations for effective remediation. Valley Water will continue to track water quality changes and work with stakeholders to identify ways to protect groundwater quality from the threat of contamination.

5.1 Regional Groundwater Quality

Valley Water analyzed groundwater quality at 85 locations that are sampled annually, including 63 monitoring wells and 22 domestic wells (Figure 20). Sixty-nine samples were analyzed for almost 50 water quality parameters including major and minor ions, nutrients, and trace metals. Analysis of volatile organic compounds is conducted every three years and is next scheduled for 2019. Water from 16 shallow monitoring wells near the San Francisco Bay, used for salt water intrusion monitoring, were analyzed for ions and metals only. The regional groundwater quality evaluation also incorporates data from 94 wells with known construction sampled through Valley Water's voluntary domestic well sampling program and data from 249 public water supply wells sampled by public water systems and reported to the State Water Resources Control Board Division of Drinking Water (DDW) .

To evaluate regional conditions, water quality results are compared to state and federal water quality standards and to prior year results. A summary table of sampled parameters showing the median and range for each subbasin and aquifer zone[23] is provided in Appendix C. Results indicate that groundwater in the Santa Clara and Llagas subbasins is generally of high quality. Water quality indicators, ions, and trace elements were within the normal range expected in groundwater, except for nitrate. Elevated nitrate concentrations are primarily an issue in South County due to historic and ongoing sources including synthetic fertilizer, septic systems, and animal enclosures.

Recent sample median concentrations for nitrate as nitrogen (N) and Total Dissolved Solids (TDS) are shown in Table 7. The median nitrate concentration is below 4 milligrams per liter (mg/L) in both the Santa Clara Plain and the Coyote Valley. Nitrate is generally higher in the Llagas Subbasin, with median concentrations of 5.5 and 8.6 mg/L in the principal and shallow aquifers, respectively. Results are within 1 mg/L of the 2017 median concentrations, except for Coyote Valley, where the median decreased from 7.2 to 3.8 mg/L in 2018. Nitrate concentrations in Coyote Valley will continue to be monitored to determine whether the large decrease is consistent or is an aberration due to a different set of wells being sampled or other unknown cause. Median TDS is 400 mg/L or less in all aquifers except for the Santa Clara Plain shallow aquifer (460 mg/L). Compared to 2017, median 2018 TDS values are marginally higher, with only Coyote Valley having a longer-term increasing concentration trend. However, some fluctuations in annual sample medians are expected based on which specific wells are tested, the number of wells tested with known well depths, and annual recharge, pumping, and rainfall. The evaluation of groundwater quality trends is presented in Section 5.2.

Fourteen individual volatile organic compounds (VOCs), which include disinfection byproducts, were detected in groundwater in 2018, as summarized and listed by subbasin in Table C-4. However, none was confirmed to be present above the Maximum Contaminant Level (MCL)[24] and maximum concentrations were typically well below the MCL. VOCs occur primarily from industrial use of solvents and from leaking underground fuel tanks. The herbicide dimethyl tetrachloroterephthalate (DCPA), which has no MCL, was detected in one sample from the Santa Clara Plain principal aquifer at 0.13 ug/L. No other herbicides or pesticides were detected in 2018.

[23] Public water supply wells were assumed to represent the principal aquifer if no construction information was available, as these are typically deep wells.

[24] See discussion of 1,2,3-trichloropropane in next section.

Figure 20. CY 2018 Groundwater Quality Monitoring Wells

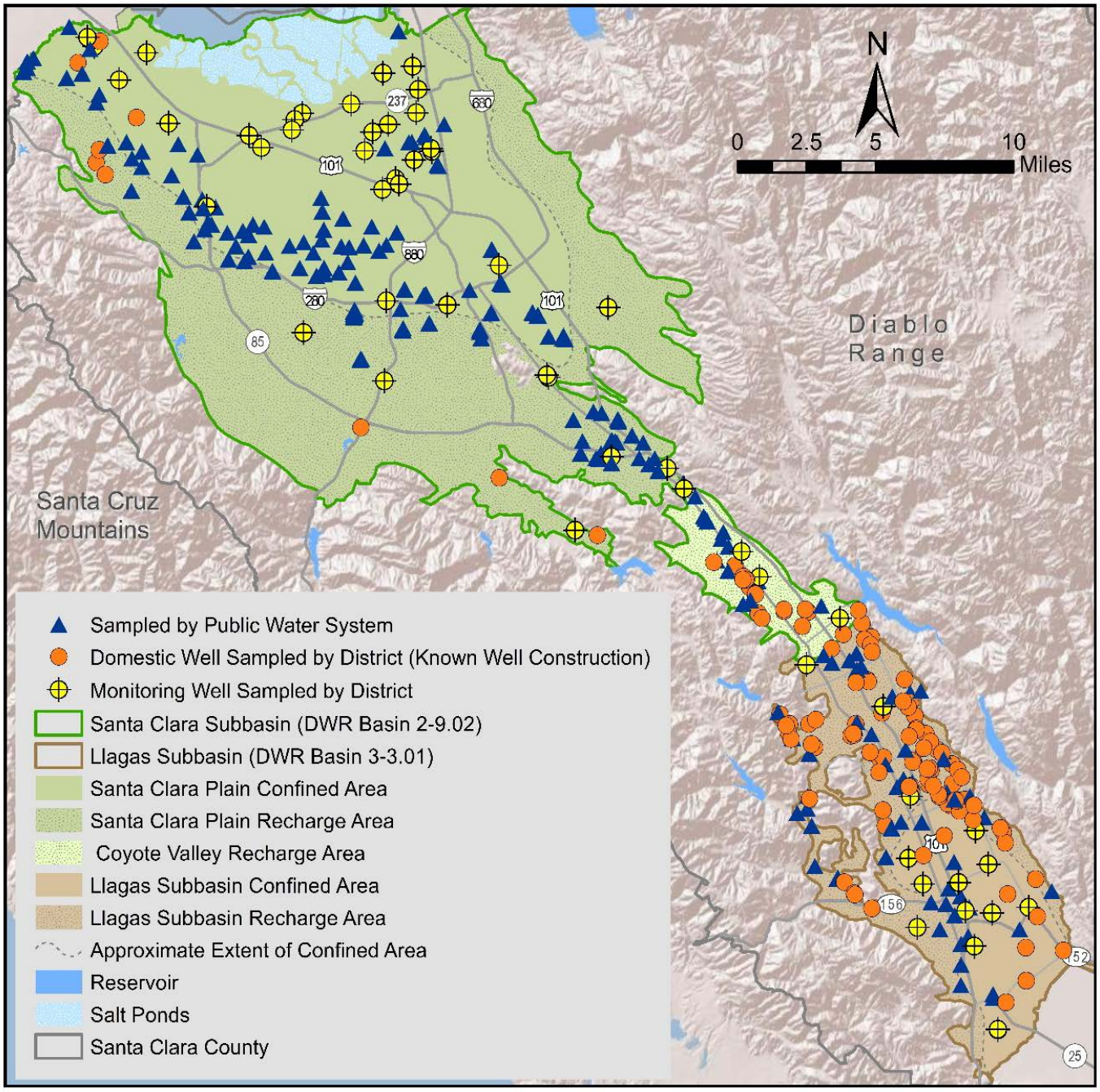


Table 7. Median Nitrate and TDS by Subbasin and Aquifer Zone (mg/L)

Parameter	Santa Clara Subbasin						Llagas Subbasin			
	Santa Clara Plain Shallow Aquifer		Santa Clara Plain Principal Aquifer		Coyote Valley		Shallow Aquifer		Principal Aquifer	
	2017	2018	2017	2018	2017	2018	2017	2018	2017	2018
Nitrate as Nitrogen(N)	1.5	1.6	3.1	3.3	7.2	3.8	10	8.6	5.2	5.5
TDS	438	460	390	400	372	394	388	378	370	387

Notes:

1. The shallow and principal aquifer zones are represented by wells primarily drawing water from depths less than and greater than 150 feet below ground surface, respectively.
2. Nitrate as Nitrogen has a health-based MCL of 10 mg/L. TDS has an aesthetic-based MCL, which ranges from 500 to 1,000 mg/L (recommended and upper limit, respectively).
3. Table 7 includes information for monitoring wells, public water supply wells, and domestic wells for which construction information is available. The set of wells sampled each year varies.
4. Median TDS in the Santa Clara Plain Shallow aquifer excludes certain wells near San Francisco Bay within the region influenced by salt water interaction.

Comparison to Drinking Water Standards

Except for nitrate, and two unconfirmed detections of 1,2,3-trichloropropane (1,2,3-TCP), all water supply wells tested (public water supply wells and private domestic wells) met all MCLs. Figure 21 presents the locations of water supply wells tested in 2018 with an MCL exceedance.[25] For public water supply wells, 98% met all MCLs, while 74% of all domestic wells met MCLs for the parameters tested (typically fewer parameters compared to public wells). 1,2,3-TCP is a volatile organic compound that has been used as a cleaning and degreasing solvent and is associated with pesticide products. The initial detections of 1,2,3-TCP in two North County wells do not indicate a widespread concern, especially since subsequent testing did not show 1,2,3-TCP to be present in those wells. These two unconfirmed detections are not considered MCL exceedances for this report.

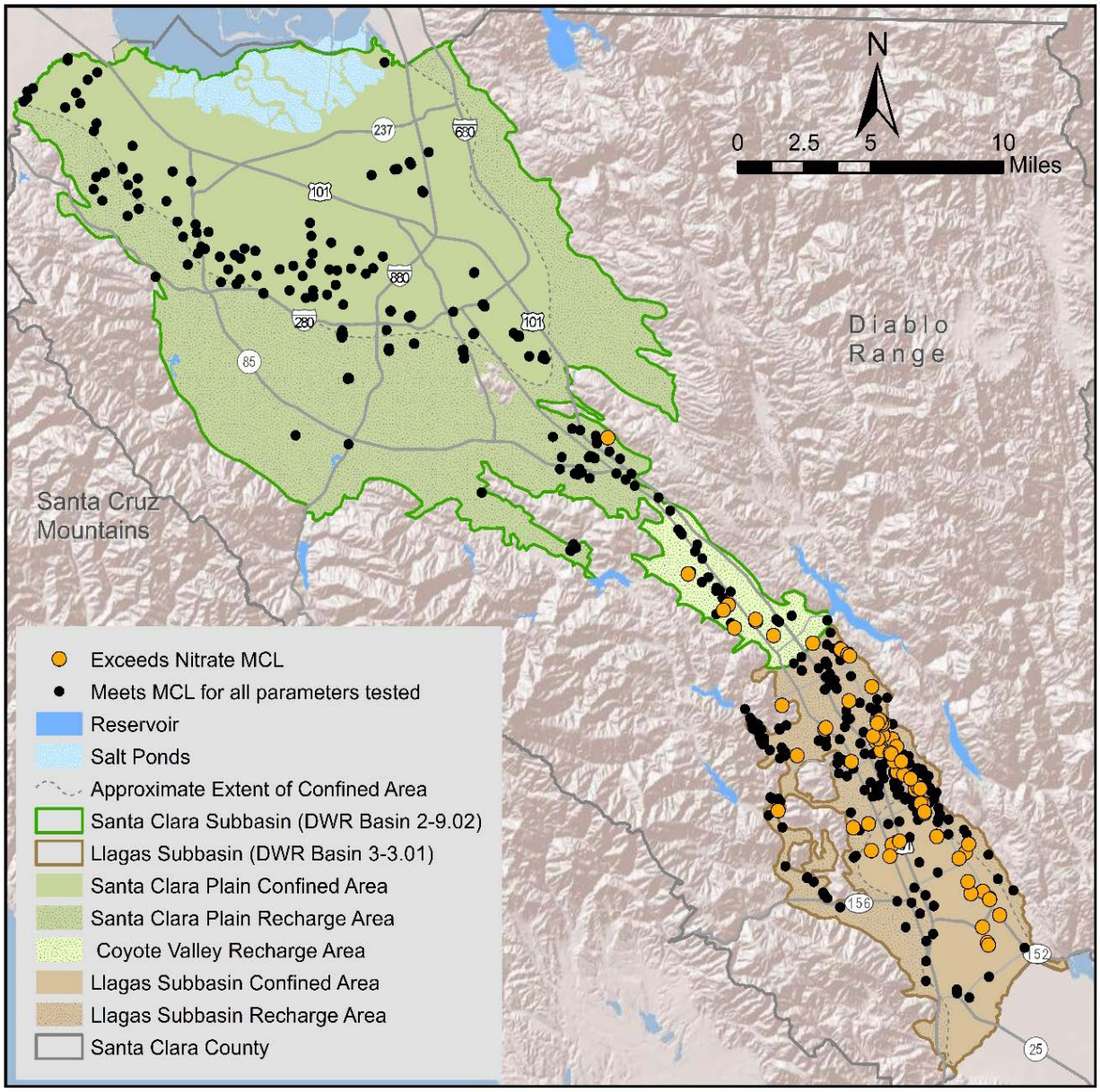
Nitrate was below the MCL (10 mg/L) in 86% of all water supply wells countywide. However, nearly one-fourth of the South County water supply wells tested in 2018 exceeded the nitrate MCL, with 7% of public water supply wells and 29% of domestic wells having at least one result above the MCL. Most detections were from private domestic wells that are not regulated by the state, while 5 wells were part of public water systems. Public water systems must comply with all drinking water standards, which may require treatment or blending prior to delivery to the customer. Based on communication with well owners participating in Valley Water sampling programs, many use bottled water for drinking and cooking, or reverse osmosis treatment to reduce nitrate exposure.

While not used as a source of drinking water, some monitoring wells sampled are screened in the principal aquifer zone. Two deep monitoring wells sampled in 2018 had detections above the MCLs for two constituents; one for nitrate (Llagas Subbasin) and one for aluminum (Santa Clara Subbasin). Eight shallow aquifer zone monitoring wells in the Llagas Subbasin had elevated nitrate. Shallow groundwater quality is important, even though it is generally

[25] For data obtained from the DDW website, any confirmed result reported above an MCL is considered an exceedance for the purposes of this report. Based on DDW regulations and follow-up sampling, a single detection above an MCL may not constitute a violation of a drinking water standard.

not used as a source of drinking water, because it is a potential water supply source and because shallow groundwater recharges the principal aquifer in recharge areas.

Figure 21. CY 2018 MCL Exceedances at Water Supply Wells



Unregulated Contaminant Monitoring

The U.S. Environmental Protection Agency (EPA) has developed a systematic process for evaluating whether individual chemicals should be regulated to ensure that drinking water poses no significant risk to the public. Every 5 years, the EPA publishes a list of unregulated compounds to be analyzed in large public water systems through the Unregulated Contaminant Monitoring Rule (UCMR). The EPA uses the UCMR to collect data on contaminants that are suspected to be present in drinking water and do not have health-based standards set under the Safe Drinking Water Act. The EPA has completed three rounds of UCMR: UCMR 1 with monitoring between 2001 and 2003, UCMR 2 with monitoring between 2008 and 2010, and UCMR 3 with monitoring between 2013 and 2015. UCMR 3 results for groundwater in Santa Clara County (sampled by water retailers) were summarized in Valley Water's Annual Groundwater Report for 2016. UCMR 4 monitoring will occur between 2018 and 2020 and includes a total of 30 contaminants including cyanotoxins, metals, pesticides and related byproducts, disinfection byproducts, alcohols, and semi-volatile organic chemicals. UCMR 4 sampling results will be evaluated and presented when available through the EPA.

Comparison to Agricultural Objectives

Agriculture in Santa Clara County is largely limited to the Coyote Valley and Llagas Subbasin. South County groundwater quality was evaluated against agricultural water quality objectives from the applicable Regional Water Quality Control Board Basin Plans[26] to assess its suitability. Because Valley Water has limited access to agricultural wells, water supply well data was used in this evaluation. Ninety-seven percent of all South County water supply wells met Basin Plan agricultural objectives. In Coyote Valley, all wells met agricultural objectives except one well for iron. In the Llagas Subbasin, seven wells did not meet agricultural limits: one for sodium, five for nitrate, and one for boron.

5.2 Groundwater Quality Trends

To assess changes in water quality over time, Valley Water evaluated concentrations for chloride, nitrate, and TDS and determined statistical trends by groundwater management area and aquifer zone. Concentration trends were evaluated for all wells sampled in 2018 that had at least five results over the last 15 years (2004 through 2018). The results show that most wells have stable or decreasing concentrations for chloride, nitrate, and TDS (Figures 22 through 24 and Table 8).

In general, chloride concentrations are stable (69%) or increasing (29%) in the Llagas Subbasin, stable in Coyote Valley, and mixed in the Santa Clara Plain. A group of wells in the northern portion of the Llagas subbasin previously showing stable chloride concentrations now shows increasing concentrations. Valley Water will continue to monitor concentrations and trends in this area. Nitrate concentrations are generally stable (69%) or decreasing (22%) countywide; these are favorable trends but high concentrations remain in some wells. A group of wells with decreasing nitrate concentrations is observed in the southern portion of the Santa Clara Plain near Coyote Valley (Figure 23). This may be the result of dilution from the managed recharge of water with low nitrate content through Coyote Creek. Though less well-defined, another group of wells with an upward nitrate concentration trend is in the downtown area of San Jose. This is likely due to remnant concentrations of nitrate from historic agricultural land use in the area. Countywide, only a small percentage of wells analyzed had increasing concentrations of TDS (8%). Increasing TDS concentrations were observed in the Santa Clara Plain shallow aquifer (11% or 3 wells) and in the Llagas Subbasin shallow aquifer (24% or 5 wells). These trends will continue to be

[26] Groundwater in the Coyote Valley is compared to the limits in Table 3-6 of the San Francisco Bay Basin Water Quality Control Plan (March 2015). Groundwater in the Llagas Subbasin is compared to the upper range of the "increasing problems" range in Table 3-3 and Table 3-4 (irrigation supply) of the Water Quality Control Plan for the Central Coast Basin (March 2016).

monitored; however, it should be noted that there are few monitoring wells in each of these shallow areas so a change in concentration in one well has a large influence on the overall trend.

Table 8. Chloride, Nitrate, and TDS Concentration Trends (2004 - 2018)

Groundwater Management Area	Parameter	Number of Wells Evaluated	Percent of Wells with Stable Concentrations	Percent of Wells with Decreasing Concentrations	Percent of Wells with Increasing Concentrations
Santa Clara Plain Shallow Aquifer	Chloride	31	68%	10%	22%
	Nitrate (as N)	22	82%	18%	0%
	TDS	28	68%	21%	11%
Santa Clara Plain Principal Aquifer	Chloride	148	87%	1%	12%
	Nitrate (as N)	255	63%	27%	10%
	TDS	145	93%	1%	6%
Coyote Valley	Chloride	19	84%	0%	16%
	Nitrate (as N)	32	69%	25%	6%
	TDS	21	95%	0%	5%
Llagas Subbasin Shallow Aquifer	Chloride	21	62%	0%	38%
	Nitrate (as N)	23	87%	4%	9%
	TDS	21	76%	0%	24%
Llagas Subbasin Principal Aquifer	Chloride	50	72%	2%	26%
	Nitrate (as N)	107	78%	14%	8%
	TDS	50	92%	2%	6%
All Groundwater Management Areas	Chloride	269	80%	2%	18%
	Nitrate (as N)	439	69%	22%	9%
	TDS	265	89%	3%	8%

The remainder of this page is intentionally left blank

Figure 22. Chloride Concentration Trends (2004 - 2018)

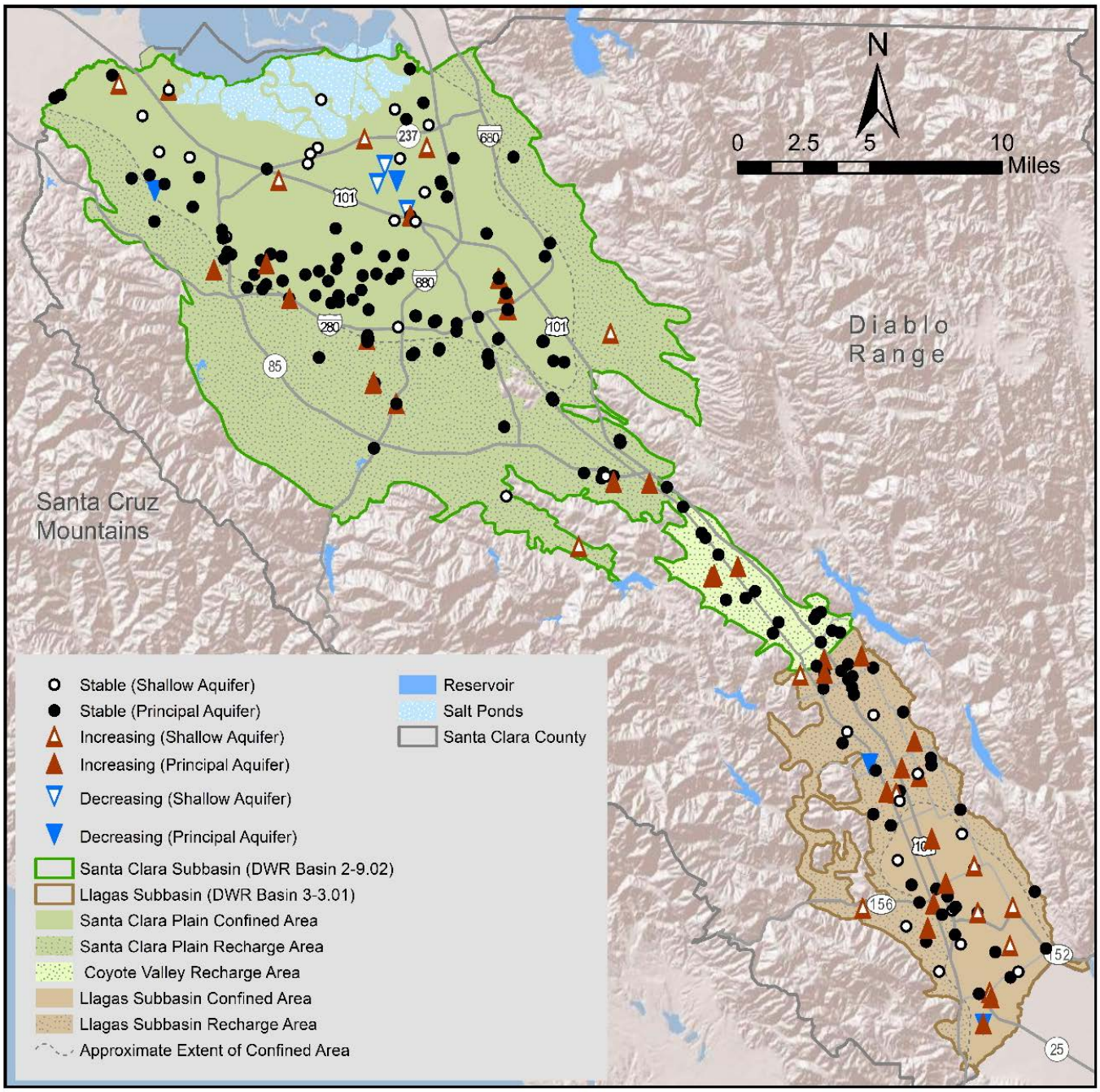


Figure 23. Nitrate Concentration Trends (2004 - 2018)

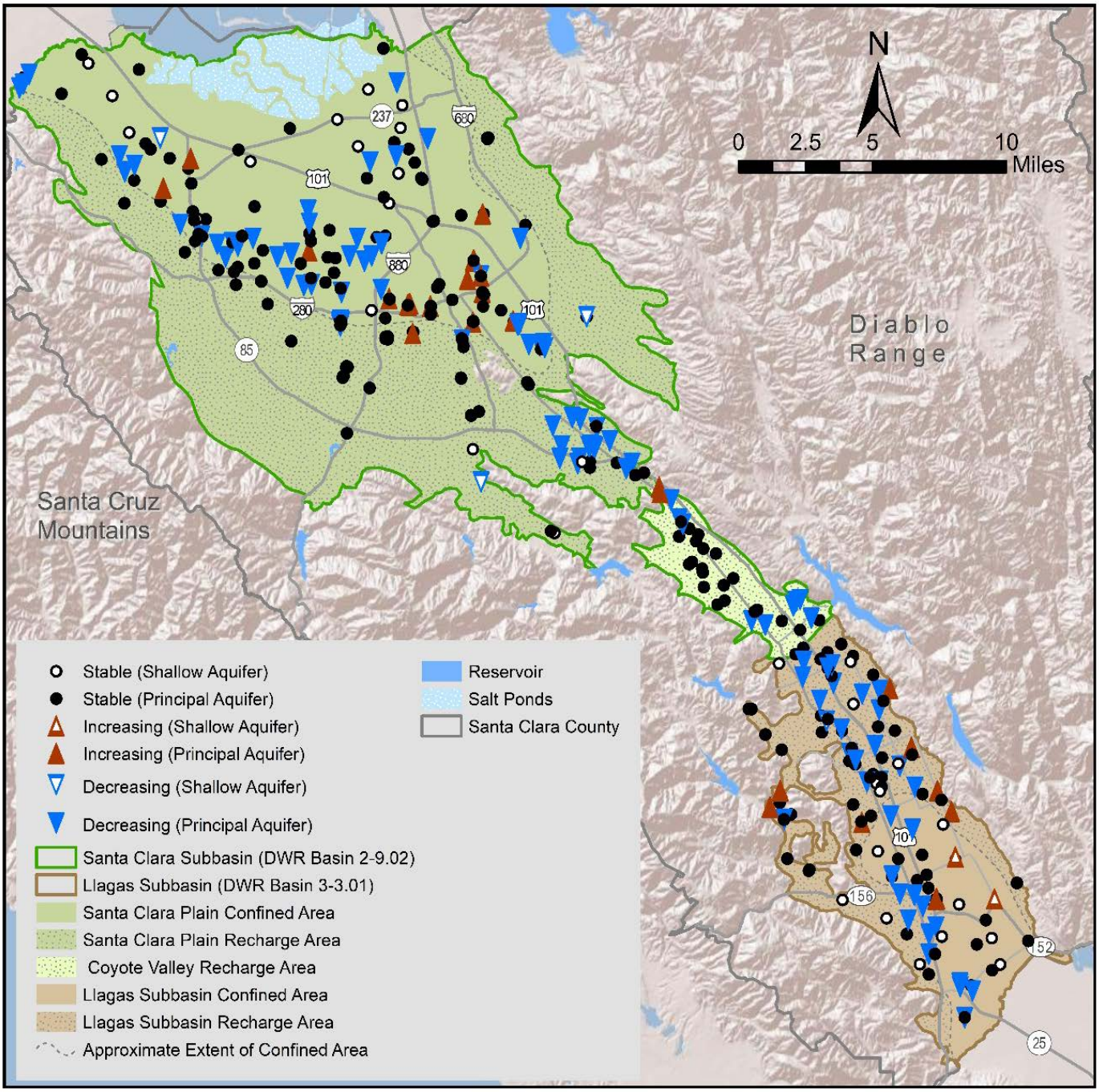
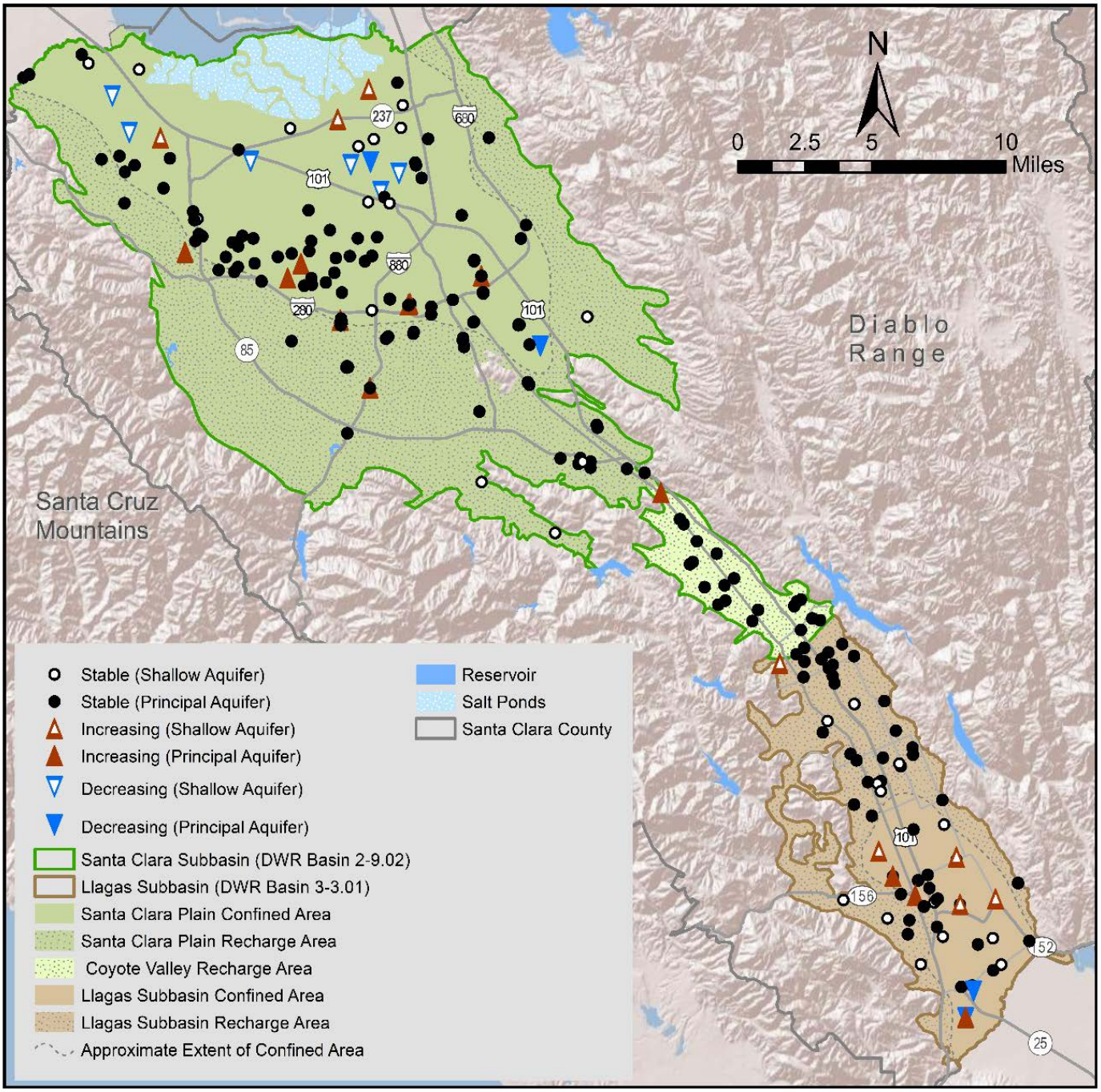


Figure 24. Total Dissolved Solids (TDS) Concentration Trends (2004 - 2018)



Valley Water also conducted a 5-year and 10-year statistical step trend analysis of nitrate and TDS concentrations by groundwater management area for the principal aquifer zone. The results (Table 9) show that there is an increase in TDS (approximately 68 mg/L) in Coyote Valley and nitrate (approximately 1 mg/L) in the Llagas Subbasin when compared to concentrations from 5 years prior (2013). Increases in TDS could be attributed to an increase in wells analyzed for TDS (TDS was added to the domestic testing program in May 2017). Increases in nitrate could be attributed to increased data from the domestic wells with known well depths in the Llagas Subbasin (about 130 in 2018 compared to about 60 in 2013). In both cases, the trends may reflect a truer picture of TDS and nitrate conditions and not necessarily an increase in concentration. Overall, nitrate and TDS groundwater concentrations remain stable across the Santa Clara Subbasin.

Table 9. Total Dissolved Solids and Nitrate Concentration Step Trends in Principal Aquifers

	2018[1]	5-Year Step Trend[2]	10-Year Step Trend
Total Dissolved Solids (TDS, mg/L)			
Santa Clara Plain	400	No Change	No Change
Coyote Valley	394	Increase (~68 mg/L)	No Change
Llagas Subbasin	387	No Change	No Change
Nitrate (as Nitrogen, mg/L)			
Santa Clara Plain	3.3	No Change	No Change
Coyote Valley	3.8	No Change	No Change
Llagas Subbasin	6	Increase (~1 mg/L)	No Change

Notes:

1. Values represent the median groundwater concentration for principal aquifer zone wells tested (both water supply wells and monitoring wells).
2. The median 2018 concentration for each groundwater management area was compared to that of 5 years ago (2013) and 10 years ago (2008) to determine if there is any statistically significant difference using the Mann-Whitney test at the 95% confidence level.

The remainder of this page is intentionally left blank

Groundwater and Salt Water Interaction

Salt water intrusion into shallow aquifers was observed historically near South San Francisco Bay and adjacent to the tidal reaches of the Guadalupe River, Coyote Creek, and other creeks in the northern portion of the Santa Clara Plain. The mechanism for this intrusion is not the classic case occurring in coastal aquifers where a wedge of sea water intrudes freshwater aquifers due to a hydraulic connection between groundwater and sea water. San Francisco Bay is a shallow feature (with average depth of 12 to 15 feet) underlain by the Bay Mud, which isolates the Bay from underlying aquifers. The Santa Clara Valley has experienced salt water incursion in streams from brackish water moving upstream, primarily in Coyote Creek and Guadalupe River, and being subsequently infiltrated to shallow aquifers that are not used to supply drinking water. As previously discussed, Valley Water has implemented managed recharge and in-lieu recharge programs to minimize the risk of groundwater overdraft, land subsidence, and salt water intrusion.

Chloride concentrations from shallow monitoring wells are used to assess groundwater and salt water interaction adjacent to southern San Francisco Bay and near tidal reaches of creeks. Valley Water uses a chloride concentration of 100 mg/L as a threshold to indicate that salt water is impacting groundwater. This is a conservative approach since the aesthetic based secondary MCL for chloride is 250 mg/L.

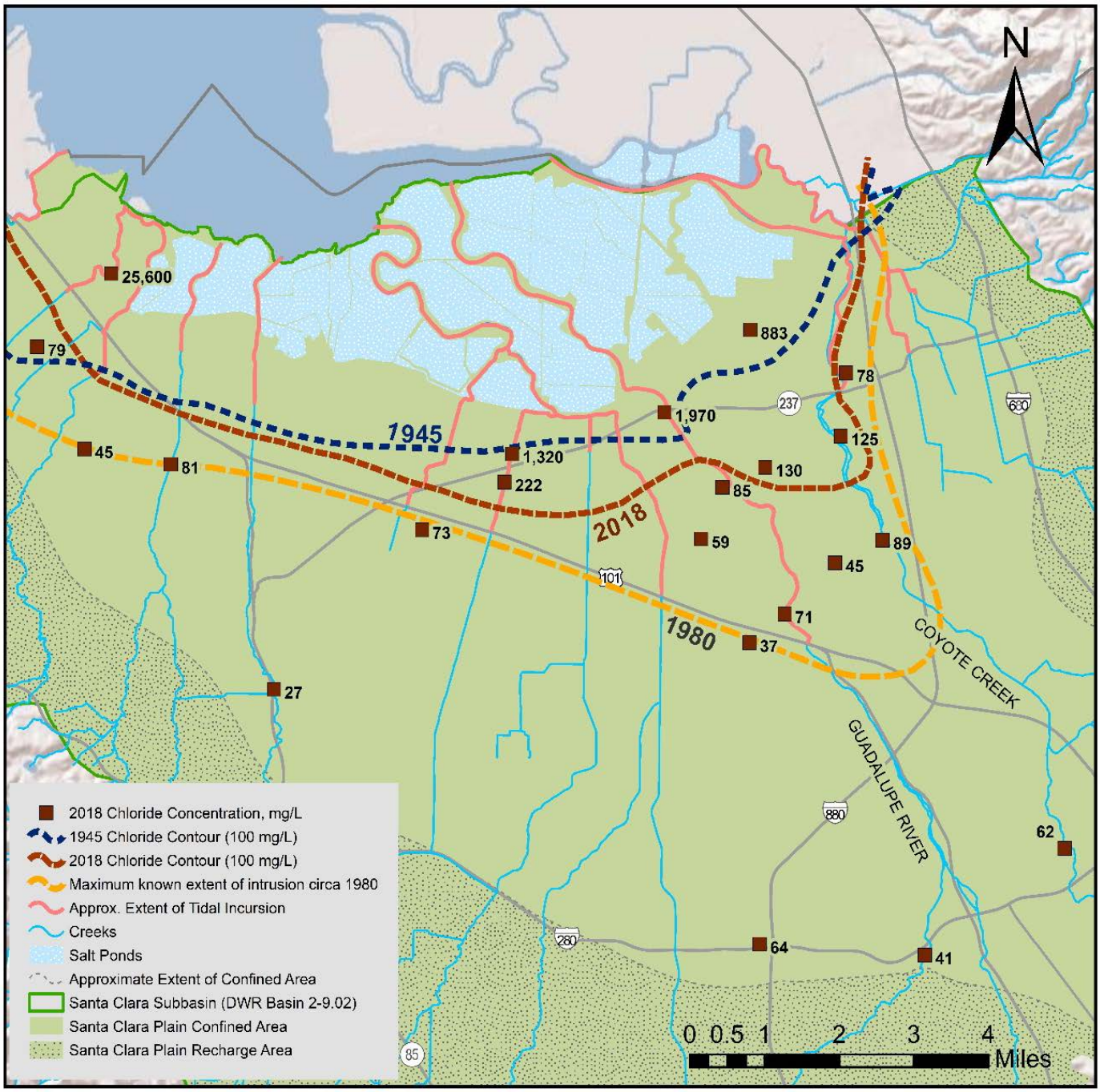
As shown on Figure 25, wells with chloride over 100 mg/L are in a narrow band near the former salt evaporation ponds, except in the areas adjacent to the tidal reaches of creeks (e.g., lower extent of the Guadalupe River and Coyote Creek). In these areas, a larger portion of the shallow aquifer is affected due to tidal influenced salt water incursion in these channels that occurs due to historic land subsidence, represented by a dashed line that shows the maximum known extent of salt water intrusion (circa 1980). A significant increase in chloride content is observed near the western edge of the salt evaporation ponds. However, most shallow wells in this area have decreasing long-term concentration trends for chloride, demonstrating that the salt water intrusion front appears to be stable or retreating since 1980 due to improved groundwater conditions.

Few wells in the principal aquifer zone have ever had highly elevated TDS or chloride concentrations. Salt water intrusion into the principal aquifer, though rare, may occur by shallow saline groundwater moving down through vertical conduits, such as abandoned wells, when the vertical hydraulic gradient is downward.[27] At isolated locations in Palo Alto and southeast San Jose, the source of elevated TDS and chloride in deeper wells there has been attributed to connate water (trapped salt water from the geologic past), rather than recent salt water intrusion. Valley Water currently conducts only limited monitoring of the principal aquifer in the Baylands area because few deeper wells are available. Migration of saline shallow groundwater into the principal aquifer has been prevented due to Valley Water's managed and in-lieu recharge activities, which maintain artesian conditions (upward vertical gradient) in the Baylands area.[28] Tidal incursion in the bayward reaches of streams still occurs and it continues to introduce saline water into the shallow aquifer, as the observed elevated and increasing chloride concentration in some shallow aquifer wells in the Baylands area indicate.

[27] Vertical gradients in the Baylands area where salt water interaction occurs have been upward for the last 20 years (approximately).

[28] Artesian conditions are facilitated by the presence of a laterally-extensive clay layer (aquitard), which confines the pressure within the principal aquifer, and isolates the principal aquifer from saline intrusion and other contamination.

Figure 25. Groundwater and Salt Water Interaction in the Santa Clara Plain Shallow Aquifer



5.3 Domestic Well Water Quality

Valley Water offers free, basic water quality testing to domestic well owners within its groundwater benefit zones through the Domestic Well Testing (DWT) program. In 2018, 19 domestic wells in North County and 193 domestic wells in South County were tested. Parameters tested include nitrate, bacteria, TDS, and hardness. As described previously, Valley Water's annual groundwater sampling also includes several domestic wells and this section summarizes those data as well. The number and locations of wells sampled under the DWT program vary by year based on voluntary participation. North County testing included 5 new wells and 14 repeat wells, while South County included 70 new wells and 123 repeat samples.

Domestic well testing helps improve Valley Water's understanding of the occurrence of common contaminants and helps private well owners understand their water quality, so they can make informed decisions. Although water quality in domestic wells is not regulated by the state, the comparison to state drinking water standards provides context for interpreting results. When testing domestic wells, Valley Water notifies well owners when any contaminants are present above drinking water standards or when bacteria is present and offers information on additional actions the well owner may wish to take. Table 10 summarizes the results for each groundwater benefit zone, including median concentrations and percent of wells with concentrations above drinking water standards.

Of the wells tested, nitrate was detected above the MCL in one North County domestic well and in 58 (30%) South County wells. The nitrate results are shown in Figure 26 relative to the MCL of 10 mg/L nitrate as nitrogen. The median nitrate concentration in domestic wells in North and South County was 1.6 mg/L and 6.3 mg/L, respectively. The 2018 regional median nitrate concentrations for the principal aquifer in the Santa Clara Plain, Coyote Valley, and Llagas Subbasin (including public water supply wells which are typically deeper) are 3.3, 3.8, and 6.0 mg/L, respectively. Overall, the South County nitrate median for domestic wells is similar to the nitrate median in the Llagas Subbasin. The number of North County domestic wells sampled is significantly lower than the number of domestic and public water supply wells sampled in the Santa Clara Subbasin.

The continued presence of nitrate above the MCL in many domestic wells in Santa Clara County and many areas of California highlights the need for ongoing efforts by regulatory and land use agencies, agricultural operators, and groundwater management agencies like Valley Water to address elevated nitrate in groundwater. To reduce well owners' exposure to nitrate, Valley Water began implementation of a multi-year rebate program for nitrate treatment systems in the fall of 2013, funded by the Safe, Clean Water and Natural Flood Protection Program (Measure B, a countywide special parcel tax). In 2018, five nitrate treatment system rebates were issued. This effort complements outreach and other efforts to reduce nitrate loading in coordination with the Central Coast Water Board and other basin stakeholders.

Testing for bacteria was carried out countywide. Total coliform bacteria were detected in 31% of the domestic wells tested, a slightly lower percentage than in 2017 (35%). Coliform bacteria are a large family of bacteria naturally present in humans, animals, and the environment and do not normally cause illness, but they should not be present in drinking water. Escherichia coli (E. coli), a type of coliform bacteria indicative of fecal contamination, was detected in 2% of the domestic well systems tested countywide. Total coliform and E. coli detections appear randomly distributed but are more frequent in the Llagas Subbasin.

Figure 26. Nitrate Results for Domestic Wells Tested in 2018

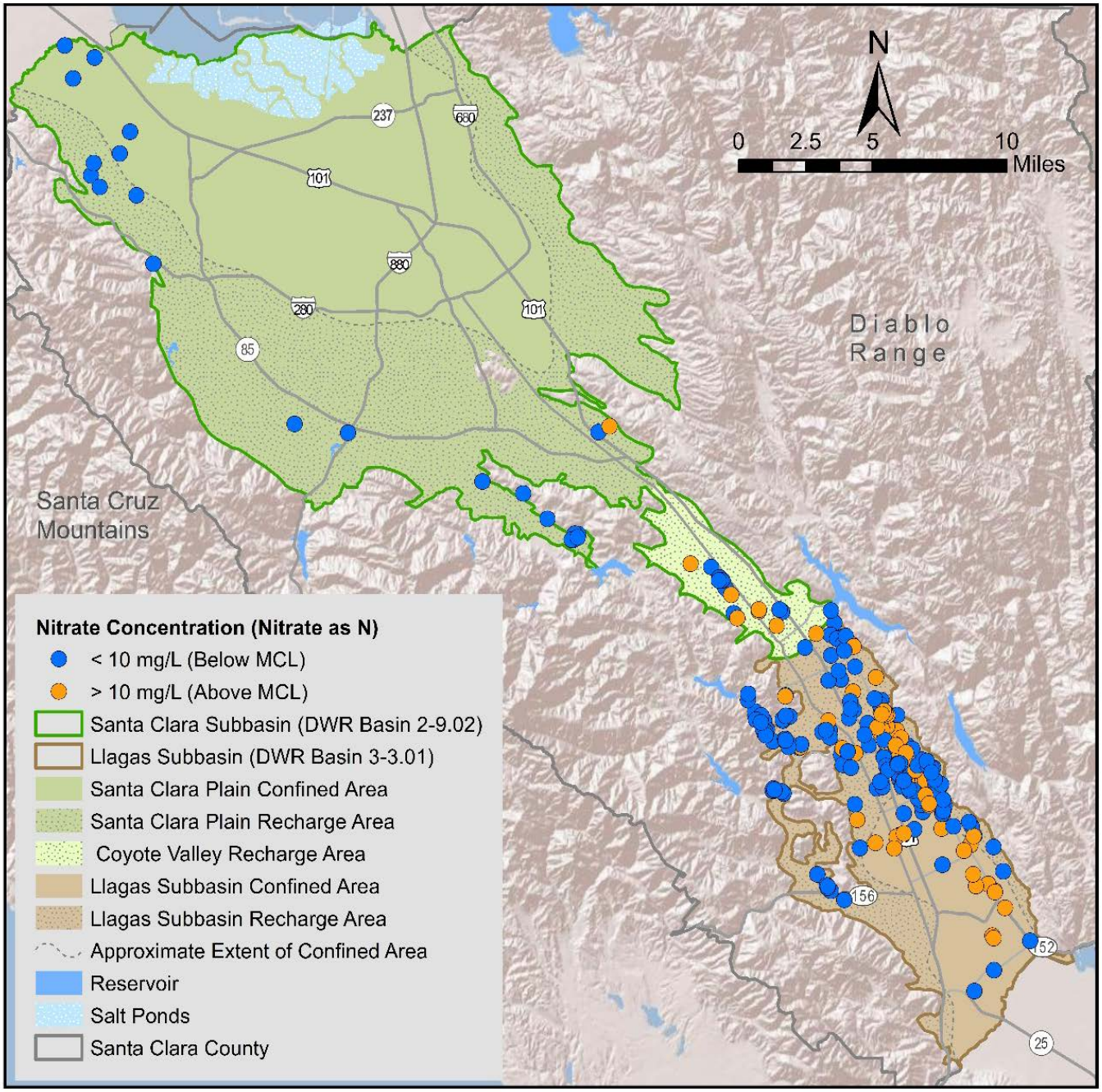


Table 10. 2018 Domestic Well Testing Results

Parameter and Units	MCL[1]	Zone W-2 North County		Zone W-5 South County	
		Median	Wells above MCL[1] (%)	Median	Wells above MCL[1] (%)
Nitrate as N (mg/L)	10 (P)	1.6	5%	6.3	30%
Fluoride (mg/L)	2 (P)	0.09	0%	0.08	0%
Sulfate (mg/L)	250 (S)	39	0%	34.6	0%
Hardness (mg/L as CaCO3)	--	295	--	263	--
		Wells with Bacteria Present (No.)	Wells with Bacteria Present (%)	Wells with Bacteria Present (No.)	Wells with Bacteria Present (%)
Total Coliform Bacteria	--[2]	10	50%	63	30%
E. Coli Bacteria	--[2]	2	10%	2	1%

Notes:

1) Maximum contaminant levels are established by the DDW for public water systems. (P) indicates the parameter has a health-based Primary MCL and (S) indicates a Secondary, aesthetic-based MCL. Hardness does not have a primary or secondary MCL but water with hardness above 180 mg/L is classified as very hard. Water quality in domestic wells is not regulated by the state.
2) Bacteria are measured as present or absent. Public water systems are required to ensure that fewer than 5% of samples have total coliform present and that no samples have E. Coli present.

The remainder of this page is intentionally left blank

5.4 Recharge Water Quality

Valley Water began monitoring surface water quality in 2006 at selected in-stream and off-stream recharge facilities to characterize recharge water quality and to assess how managed recharge influences groundwater quality. Per Valley Water's GWMP, each of the seven major recharge systems is to be sampled every three years. Analysis includes major and minor ions, trace elements, metals, organic compounds, and field data (e.g. temperature, electrical conductance, dissolved oxygen, pH, etc.)

In 2018, a limited sampling effort was performed of the Lower and Upper Llagas Recharge Systems since the North County recharge systems scheduled for sampling were not in use due to full basin conditions. A review of all historic data suggests that recharge water quality is generally good and is typically similar to or better than the underlying groundwater quality with some exceptions. Although managed recharge water is not suitable for direct consumption before treatment or infiltration, comparing it to health-based drinking water standards provides context for results. No parameters were detected above these standards in any recharge water samples collected in 2018 or since 2006.

In September 2018, Uvas Creek, part of the Lower Llagas Recharge System relying on local surface water, was sampled at three stations. The Main Avenue Ponds and the San Pedro Ponds, part of the Upper Llagas Recharge System, were also sampled. The data is presented in Appendix D. In the Lower Llagas Recharge System, TDS and chloride are generally low, ranging from about 200 mg/L to less than 250 mg/L and 9 mg/L to 13 mg/L, respectively. Nitrate and phosphate were present at low concentrations of about 0.2 mg/L. Pesticides and volatile organic compounds were not detected in any sample collected. In general, water from Uvas Creek has a calcium-magnesium bicarbonate character, is low in nitrate and TDS, and lacks chemical impurities, providing good water quality for recharge into the Llagas Subbasin.

The quality of water encountered in the Upper Llagas Recharge System (Main Avenue and San Pedro Ponds) was also investigated in September 2018. Both ponds are supplied with imported water under normal operating conditions. Consequently, basic water quality at each pond is essentially identical (see table 1, Appendix D). TDS concentrations were about 250 mg/L, chloride was present at 70 mg/L, and nitrate non-detectable. The chloride and sodium levels found are higher than those of ambient groundwater in the Llagas Subbasin but not substantially different from past sampling events. Potential effects on groundwater quality will be evaluated further.

5.5 Monitoring Near Recycled Water Irrigation Sites

Valley Water partners with four recycled water producers in the county[29] to provide recycled water for non-potable purposes like landscape and agriculture irrigation and industrial processes. Tertiary treated recycled water (recycled water) generally has higher concentrations of salts, nutrients, disinfection byproducts, and emerging contaminants than local groundwater or potable treated water.[30] Previous studies have shown that some contaminants can migrate to shallow groundwater when turf and other landscaping is irrigated with recycled water.[31]

---

[29] Recycled water is produced at the Palo Alto Regional Water Quality Control Plant, San Jose/Santa Clara Water Pollution Control Plant (WPCP), the Sunnyvale WPCP and the South County Regional Wastewater Authority (SCRWA).

[30] Advanced Recycled Water Treatment Feasibility Project, Black & Veatch, Kennedy/Jenks for the Santa Clara Valley Water District, August 2003. In the Llagas subbasin, nutrient content of recycled water is lower than ambient groundwater concentrations (Llagas Subbasin Salt and Nutrient Management Plan).

[31] California GAMA Program: Fate and Transport of Wastewater Indicators: Results from Ambient Groundwater and from Groundwater Directly Influenced by Wastewater, Lawrence Livermore National Laboratory and California State Water Resources Control Board, June 2006.

To further understand the effects of recycled water, Valley Water conducts groundwater monitoring at 25 wells near recycled water irrigation sites and obtains additional monitoring data from South Bay Water Recycling. The 2018 recycled water sampling events and results are summarized below in Table 11. More detailed discussion of current and past monitoring results is provided in Appendix E.

Table 11. Summary of 2018 Groundwater Monitoring Events near Recycled Water Irrigation Sites

Subbasin	Location	Sampling Agency	Sampling Summary
Santa Clara Subbasin (Santa Clara Plain)	Integrated Device Technology (IDT) Campus, Edenvale area of San Jose	IDT and Valley Water	• Groundwater from four shallow wells was sampled in May 2018 • Recycled water delivered to this site was sampled in May 2018
	Various Locations in San Jose	South Bay Water Recycling (SBWR)	• Groundwater from six shallow wells and four deep wells was monitored in February 2018 by the City of San Jose per their Groundwater Mitigation and Monitoring Plan (GMMP)
Llagas Subbasin	Christmas Hill Park, Gilroy	Valley Water	• Groundwater from three shallow wells was sampled in March and September 2018 • Recycled water delivered to this site was sampled in March and September 2018
	Irrigated Land Near SCRWA Plant, Gilroy	Valley Water	• Groundwater from three shallow wells and one deep well was sampled in March and September 2018 • Recycled water delivered to the site from the SCRWA plant was sampled in March and September 2018
	Irrigated Land Along Expanded Recycled Water Pipelines (West Gilroy)	Valley Water	• Groundwater from 12 shallow monitoring wells was sampled in March 2018 and groundwater from 8 shallow wells was sampled in September 2018.

Santa Clara Subbasin

Sites monitored by SBWR and Valley Water (IDT site) for the effects of recycled water irrigation on groundwater in the Santa Clara Plain are shown on Figure 27. The parameters analyzed by SBWR include basic salts and minerals, alkalinity, and TDS. Valley Water analyzes the IDT samples for basic quality parameters, ions, disinfection byproducts (DBPs), PFAS, NDMA, bacterial parameters, and other parameters commonly encountered in recycled water.

The presence of potential wastewater indicators and increasing concentrations of many inorganic constituents suggest that landscape irrigation with recycled water is causing some water quality impacts in one monitoring well at the IDT site in south San Jose. The sites monitored by SBWR are more difficult to assess since related analyses do not include potential wastewater indicators and disinfection byproducts. In addition, at least two of the SBWR sites appear to have pre-existing water quality impacts from unknown source(s). However, it does appear that some changes in shallow groundwater quality because of recycled water irrigation at the SBWR sites have occurred since

monitoring began. The sites where this is most clear, based on analysis of geochemical data, are Evergreen Park, Happy Hollow, The Plant, and Solari Park. At these facilities, some evolution of water composition is noted towards one that resembles recycled water; however, simple mixing is not observed. Thus, changes in quality in these shallow wells may be related to recycled water use; however, other processes also affect water quality. Trends were computed using a quantitative statistical procedure known as Kendall's tau. The period examined is from the beginning of the electronic record for each monitoring station and parameter to the current reporting year since any changes in quality occurring since monitoring began is of interest. Results are summarized in the table below (Table 12). A more detailed well-by-well accounting of trend results is provided in Appendix E.

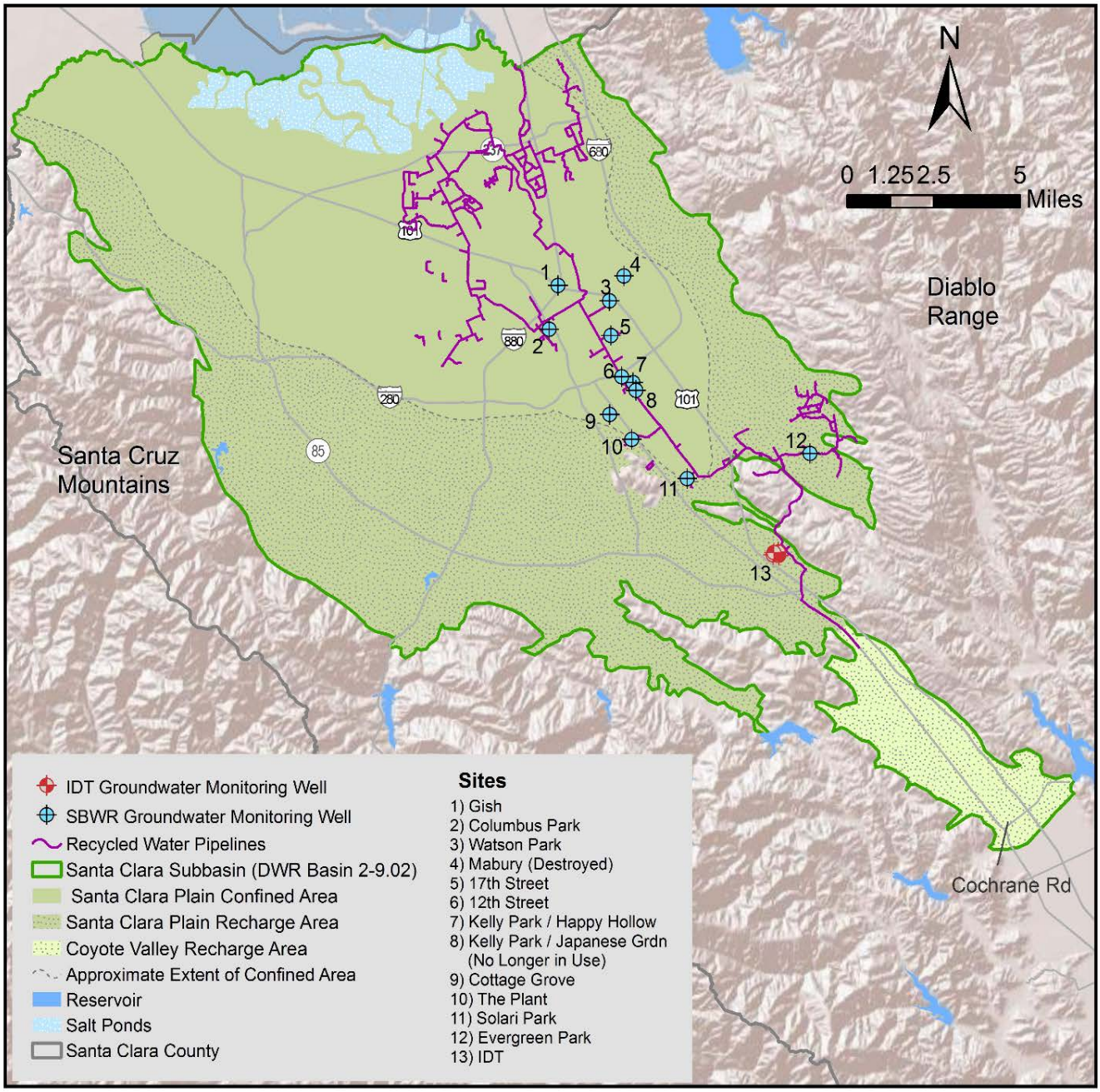
Valley Water and SBWR have worked to improve recycled water quality for irrigation and other purposes. Since March 2014, recycled water provided by SBWR has been blended with advanced treated water from Valley Water's Silicon Valley Advanced Water Purification Center, which produces up to eight million gallons of water a day. The final, blended recycled water quality is improved, with TDS lowered from about 750 mg/L to about 500 mg/L.

Table 12. Groundwater Quality Concentration Trends at Santa Clara Plain Recycled Water Irrigation Sites

Parameter	Number of Wells with Increasing Concentrations	Number of Wells with Stable Concentrations	Number of Wells with Decreasing Concentrations
Bicarbonate	1	11	4
Bromide	1	3	0
Calcium	6	9	1
Chloride	10	6	0
Magnesium	5	11	0
Nitrate	4	8	4
N-Nitrosodimethylamine (NDMA)	0	4	0
N-Nitrosodi-n-Butylamine (NDBA)	0	4	0
Perfluorooctanoic Acid (PFOA)	0	4	0
Perfluorooctane Sulfonate (PFOS)	0	4	0
Perfluorobutanoic Acid (PFBA)	0	4	0
Potassium	4	11	1
Sodium	6	10	0
Sulfate	3	10	3
Total Dissolved Solids (TDS)	3	12	1

Note: Table 12 summarizes the trend analysis for wells with more than five data points for a given parameter over a varying period of record, with the earliest data point in 1997. The total number of wells for each parameter is either 4 or 17; some parameters were monitored in all wells while other parameters were monitored only in the four IDT wells. Trends were analyzed with the Mann-Kendall technique.

Figure 27. Groundwater Monitoring Near Santa Clara Subbasin Recycled Water Irrigation Sites



Llagas Subbasin

Recycled water used in the Llagas Subbasin is tertiary recycled water produced by the SCRWA facility and then distributed to several locations in Gilroy. Valley Water monitors groundwater in 20 wells at six recycled water irrigation or pipeline sites (Figure 28). The sites monitored are: Christmas Hill Park, SCRWA Facility, McCarthy Ranch, Princevalle Drain, Sports Park, and Third Street Park. Water samples are analyzed for basic water quality parameters, ions, DBPs, PFAS, NDMA, bacterial parameters, and other parameters commonly encountered in recycled water.

The site having the longest period of receiving recycled water and monitoring in the Llagas Subbasin is the Christmas Hill Park site in Gilroy. Detection of some potential wastewater indicators, increasing concentrations of common ions, and analysis of geochemical data suggest changes in quality have occurred at the site. The SCRWA facility also has a long period of recycled water irrigation use and has a history of detections of potential wastewater indicators and increasing concentrations. The other sites in the Llagas Subbasin are relatively new and have been monitored only for a few years. More data is needed before any meaningful assessment can be made at these sites.

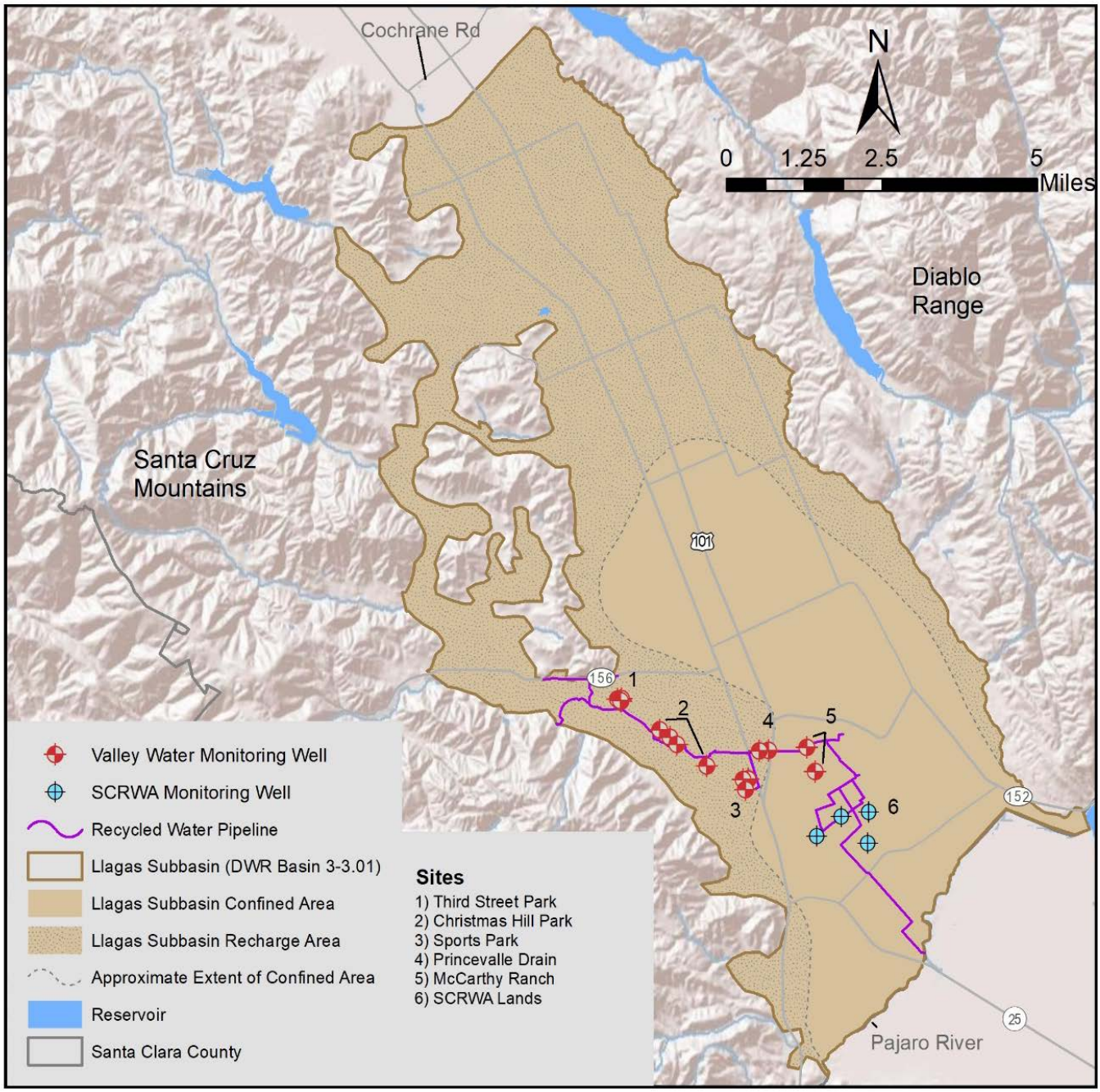
Trends of important water quality constituents were computed using a quantitative statistical procedure known as Kendall's tau. The period examined is from the beginning of the electronic record for each monitoring station and parameter to the current reporting year since changes occurring since monitoring began is of interest. Results are summarized in the table below (Table 13). A more detailed well-by-well accounting of trend results is provided in Appendix E.

Table 13. Groundwater Quality Concentration Trends at Llagas Subbasin Recycled Water Irrigation Sites

Parameter	Number of Wells with Increasing Concentrations	Number of Wells with Stable Concentrations	Number of Wells with Decreasing Concentrations
Bicarbonate	1	17	1
Bromide	0	18	1
Calcium	1	18	0
Chloride	1	17	1
Magnesium	1	18	0
Nitrate	0	19	0
N-Nitrosodimethylamine (NDMA)	0	19	0
N-Nitrosodi-n-Butylamine (NDBA)	0	19	0
Perfluorooctanoic Acid (PFOA)	0	18	1
Perfluorooctane Sulfonate (PFOS)	0	19	0
Perfluorobutanoic Acid (PFBA)	0	18	1
Potassium	6	13	0
Sodium	2	17	0
Sulfate	1	18	0
Total Dissolved Solids (TDS)	0	17	2

Note: Table 13 summarizes the concentration trend analysis for wells with more than five data points for a given parameter over a varying period of record with the earliest data point in 2002. Trends were analyzed with the Mann-Kendall technique

Figure 28. Groundwater Monitoring Near Llagas Subbasin Recycled Water Irrigation Sites



5.6 Salt and Nutrient Management Plans

The SWRCB's 2009 Recycled Water Policy required the development of regional Salt and Nutrient Management Plans (SNMPs) to address current and future regional salt and nutrient loading to groundwater from all sources, including recycled water and agricultural activity. Valley Water completed two SNMPs, one for the Santa Clara Subbasin and one for the Llagas Subbasin by working with local stakeholders and regulators. The plans are posted to Valley Water's website[32] and include salt and nutrient source identification, loading, assimilative capacity estimates, recycled water projections, implementation measures, groundwater monitoring provisions, and an anti-degradation analysis. The San Francisco Bay Regional Water Quality Control Board adopted resolution R2-2016-0046 approving the Santa Clara Subbasin SNMP in November 2016. The Central Coast Regional Water Quality Control Board does not plan to endorse specific SNMPs. Both agencies will use these plans to evaluate future recycled water projects.

The SNMPs estimate and project long-term trends in concentrations of salts (using TDS) and nutrients (using nitrate) in groundwater through the year 2035. In general, the main sources for salt loading in the Santa Clara Plain are landscape irrigation and managed recharge, followed by recycled water, whereas agricultural irrigation and managed recharge are the main contributors for the Llagas Subbasin. Table 14 compares the SNMP projections for 2018 with the median values based on groundwater samples in 2018.

Table 14. Comparison of 2018 Median Concentrations with Projected 2018 SNMP Median Concentrations

Groundwater Management Area	2018 SNMP Projected Median	2018 Actual Median	2018 SNMP Projected Median	2018 Actual Median
	TDS, in mg/L		Nitrate as N, in mg/L	
Santa Clara Plain	433	400	2.2	3.3
Coyote Valley	317	394	3.3	3.8
Llagas Subbasin, Shallow Zone	396	378	7.0	8.6
Llagas Subbasin, Principal Zone	376	387	6.4	5.5

Notes:

1. The projected medians are based on the 2018 estimates from the SNMPs. The actual medians are based on 2018 groundwater sample analysis. The Llagas Subbasin SNMP projects the median for both the northern and southern portions of the subbasin. The projected SNMP median shown in this table for each aquifer zone is the average of the north and south subbasin medians.
2. June 2016 SNMP Santa Clara Plain projected median concentrations were not evaluated for shallow and principal aquifer zones separately.

Measured median concentrations of TDS and nitrate are generally in line with SNMP projections for the Santa Clara Plain and Llagas Subbasin principal zone. In the Llagas Subbasin shallow zone, measured TDS concentrations are slightly lower than projected in the SNMP, whereas nitrate concentrations are higher. In Coyote Valley, measured TDS levels are higher than what was projected in the SNMP. Both projected and actual measured medians remain below water quality thresholds established in the Regional Water Quality Control Board's Basin Plans for the Santa Clara and Llagas subbasins.

[32] https://www.valleywater.org/your-water/where-your-water-comes-from/groundwater/groundwater-studies

Discrepancies may be attributed to the SNMP assumptions to project future salt and nutrient concentrations, such as instantaneous mixing, which may estimate higher concentrations than will occur, such as the higher TDS in the Santa Clara Plain. As shown in Table 8 and Figures 23 and 24, regional trends for both TDS and nitrate concentrations are generally stable or decreasing in the Santa Clara Plain, Coyote Valley, and the Llagas Subbasin. Valley Water will continue to evaluate measured and projected TDS and nitrate concentrations and their relationship to hydrologic conditions to better understand the causes for fluctuations including the effects on shallow and principal groundwater aquifers.

5.7 Contaminant Release Sites

There are over 350 open cases where non-fuel contaminants have been released to soil and/or groundwater in Santa Clara County. These cases are overseen by the United States Environmental Protection Agency (EPA), California Department of Toxic Substances Control (DTSC), and the Central Coast and San Francisco Bay Regional Water Quality Control Boards (Water Boards). There are also nearly 100 open fuel leak cases overseen by the Santa Clara County Department of Environmental Health (DEH). Of these, 10 are eligible for closure, 24 are undergoing site assessment, 13 are undergoing remediation, 23 are in verification monitoring, and the rest are inactive. In addition, there are over 20 active Superfund sites in Santa Clara County overseen by the EPA. Although there have been very limited impacts to principal drinking water aquifers from these sites, contaminant release sites pose an ongoing threat to groundwater quality.

In 2018, seven drinking water supply wells had low-level detections of 12 different VOCs.[33] All concentrations of these detected contaminants were below regulatory thresholds, as summarized in Appendix C, Table C-4. The interconnection between contaminant releases and drinking water supply wells underscores the importance of the ongoing work by the Water Boards, DTSC, EPA, and other regulatory agencies to ensure that contaminant release sites are properly remediated to ensure water supply reliability.

Valley Water engages with the primary oversight agencies on certain contaminant release cases based on groundwater vulnerability, proximity to water supply wells or surface water, and contaminant concentration. Valley Water staff reviews monitoring and progress reports submitted to regulatory agencies by responsible parties, as well as any regulatory orders or correspondence. Staff attends community meetings for high-threat cases and advocates for expedited cleanup through collaboration with regulatory agencies. Valley Water also provides technical review of other contaminant release sites when requested by regulatory agencies, and shares groundwater data to support their work.

In 2018, the following high-priority contaminant release cases had noteworthy developments:

Olin Corporation, 425 Tennant Avenue, Morgan Hill

Perchlorate cleanup activities by the responsible party are ongoing and include operation of the off-site groundwater extraction and treatment system. In the first half of 2018, over 300 AF of groundwater were treated and approximately 5.5 pounds of perchlorate were removed. These values are lower than the 2017 totals (as expected) due to the continued lowering of perchlorate concentrations [34] in the extraction wells, two of which were subsequently taken offline in September of 2018. Since 2004, approximately 1.36 billion gallons (4,200 AF) of groundwater have been treated, removing a total of 239 pounds of perchlorate.

[33] None of the wells with VOC detections had all compounds detected; typically, just one or a few related compounds were detected in a single well.

[34] Olin Corporation, 2018. Request to Terminate Groundwater Extraction at IEW-1R and DEW-1, Olin Site, Morgan Hill, CA. Available on www.GeoTracker.gov

Olin Corporation, the responsible party, is currently in the final stages of expanding the off-site groundwater extraction system to provide increased capture in the intermediate aquifer immediately south of the release site. The goal of the expansion is to control perchlorate migration and continue to shrink the extent of the plume. Extraction system expansion is scheduled to be completed by April 2019 and will consist of three new groundwater extraction wells. [35]

Olin's analysis of regional perchlorate monitoring results in the first half of 2018 suggest that trends in concentrations are stable or declining in all aquifers throughout the Llagas Subbasin.[36] While the number of domestic wells impacted by perchlorate has been dramatically reduced, there remain seven domestic wells with perchlorate concentrations above the 6 ug/L MCL. Olin's consultants conclude that the plume core is stable or shrinking and recommend that monitored attenuation remain the primary means for addressing remediation outside the plume core. District staff continues to review related site submittals, engage with the Central Coast Water Board, participate in Perchlorate Community Advisory Group meetings, and advocate for expedited cleanup.

Hillview Cleaners, 14440 Big Basin Way, Saratoga

The Hillview Cleaners site is a dry cleaner site that has released perchloroethene (PCE) to soil and groundwater, resulting in PCE discharges to Saratoga Creek. Two pilot studies were completed at the site, including injection of electron donor compounds to enhance anaerobic biodegradation of PCE. Implementation of the approved Remedial Action Plan, which proposes enhanced bioremediation at select locations adjacent to the site and downgradient of the site, south of Big Basin Way, began in January of 2019. Valley Water will continue to engage in the review of related site documents, engage with the San Francisco Bay Water Board, and advocate for timely and thorough cleanup.

Moffett Field, Middlefield-Ellis-Whisman (MEW) Sites, Mountain View

This area includes four Superfund sites and more than 15 individual contaminant release sites with soil and shallow groundwater contamination by trichloroethene (TCE) and other VOCs. MEW has reduced site-wide groundwater level monitoring and groundwater quality sampling to annual and biennial frequencies, respectively. A groundwater extraction and treatment system located at the former Raytheon Company site, 350 Ellis Street, began operation in December of 2003. In 2018, the groundwater treatment system pumped approximately 13.4 million gallons of groundwater (41 AF) and removed approximately 418 pounds of VOCs.[37] Valley Water staff continues to participate in related MEW, Moffett Field Regional Advisory Board and EPA community meetings.

United Technologies Corporation, 600 Metcalf Road, San Jose

United Technologies Corporation owns and occupies a large (5,113 acre) property upstream of Anderson Reservoir, where it has operated a solid rocket motor research and development facility since 1959. Various VOCs and perchlorate have been released from the site and detected in soil, groundwater, and seasonal creeks. Between May 2017 and April 2018, perchlorate concentrations reported from creek sampling stations downgradient of the site showed relatively stable concentration trends. Elevated perchlorate concentrations at two sampling locations were attributed to low rainfall within the evaluated reporting period and increased groundwater influence under

[35] Olin Corporation, 2018. 100% Design Report for the Upper Intermediate Source Control System (UI SCS), 425 Tennant Ave, Morgan Hill, CA. Available on www.GeoTracker.gov

[36] Olin Corporation, 2018. 2018 Semiannual Groundwater Monitoring Report, 425 Tennant Ave, Morgan Hill, CA. Available on www.GeoTracker.gov

[37] Haley Aldrich, 2019. NPDES Self-Monitoring Report, Reporting Period 1 January 2018 Through 31 December 2018, Raytheon Company, 350 Ellis Street, Mountain View, California. Available on www.geotracker.gov

gaining stream conditions. However, perchlorate has not been detected in Anderson Reservoir above laboratory reporting limits. Between the same period, approximately 38.04 million gallons (118 AF) of groundwater were treated, removing 25.69 pounds of VOCs, 191.61 pounds of perchlorate, and 1.97 pounds of 1,4-dioxane.[38] Concentrations of perchlorate, VOCs, and 1,4-dioxane in monitoring wells remained relatively constant. Monitoring data demonstrate that multiple extraction wells maintain hydraulic control to prevent further migration of contaminated groundwater from the site. Performance of the three in-situ bioremediation trenches and associated in-trench bioremediation injection wells was monitored and results show that with a few exceptions, the trenches are performing as intended. UTC reports monitoring results annually in July. Valley Water will continue to review related site documents and encourage timely cleanup.

Fuel Leak Cases

Valley Water continues to coordinate with the DEH through technical support and review. Valley Water received 3 public notices of proposed site closures; all closures appeared to be warranted and no comments were submitted.

5.8 Well Ordinance Program

Valley Water's well ordinance program helps ensure wells and other deep excavations are properly constructed, maintained, and destroyed to prevent vertical transport of contaminants into deep drinking water aquifers. Over 1,200 permits were issued in 2018 for well construction, for well destruction, and for exploratory borings. Valley Water inspected over 1,000 wells and borings to ensure they were properly constructed or destroyed (Table 15).

Table 15. CY 2018 Valley Water Well Permit and Inspection Summary

Permit Type	Number Processed
Well Construction - Water Producing Wells	74
Well Construction - Monitoring Wells	299
Well Destruction	602
Exploratory Boring	249
Total	1,224
Inspection Type	**Number Inspected**
Well Construction - Water Producing Wells	48
Well Construction - Monitoring Wells	280
Well Destruction	496
Exploratory Boring	220
Total	1,044

[38] Arcadis, 2018. 2018 Annual Environmental Monitoring Program Report, United Technologies Corporation, 600 Metcalf Road, San Jose, California. Available on www.geotracker.gov

Groundwater Quality Outcome Measures

The evaluation of 2018 groundwater quality data relative to the GWMP outcome measures is summarized below. Additional discussion of outcome measures, including planned action to address measures not being met, is presented in Chapter 6.

OM 2.1.1.e. At least 95% of countywide water supply wells meet primary drinking water standards.
Outcome not met. Only 86% of countywide water supply wells tested in 2018 met all primary drinking water standards; 100% of countywide water supply wells met all primary drinking water standards when excluding nitrate exceedances. Most MCL exceedances were due to elevated nitrate levels in South County, primarily in domestic wells.

OM 2.1.1.f. At least 90% of Coyote Valley and Llagas Subbasin wells meet Basin Plan agricultural objectives.
Outcome met. This measure is met with 97% of all Coyote Valley and Llagas Subbasin wells meeting Basin Plan agricultural objectives in 2018.

OM 2.1.1.g. At least 90% of wells have stable or decreasing concentrations of nitrate, chloride, and total dissolved solids.
Outcome partially met. This measure is not met for chloride, with only 82% of wells having stable or decreasing concentrations. The measure is met for nitrate and for total dissolved solids with 91% and 92%, respectively, of wells with stable or decreasing concentrations.

CHAPTER 6 – GROUNDWATER MANAGEMENT PLAN IMPLEMENTATION

This chapter summarizes the status of Valley Water's Groundwater Management Plan (Plan) implementation, including outcome measure performance, recommendations, and SGMA compliance.

6.1 Outcome Measure Performance and Action Plan

The Plan identifies outcome measures to assess performance relative to Board policy and groundwater sustainability goals. The status using 2018 data is shown below, with related actions to address measures not being met.

Table 16. Summary of Outcome Measure Performance

Groundwater Storage	**OM 2.1.1.a.** Greater than 278,000 AF of projected end of year groundwater storage in the Santa Clara Plain. **Measure met:** Estimated end of 2018 storage: 324,200 AF **OM 2.1.1.b.** Greater than 5,000 AF of projected end of year groundwater storage in the Coyote Valley. **Measure met:** Estimated end of 2018 storage: 7,600 AF **OM 2.1.1.c.** Greater than 17,000 AF of projected end of year groundwater storage in the Llagas Subbasin. **Measure met:** Estimated end of 2018 storage: 20,700 AF
Groundwater Levels and Subsidence	**OM 2.1.1.d.** 100% of subsidence index wells with groundwater levels above subsidence thresholds. **Measure met:** All ten wells had groundwater levels above thresholds in 2018.
Groundwater Quality	**OM 2.1.1.e.** At least 95% of countywide water supply wells meet primary drinking water standards. **Measure not met:** Only 86% of wells tested in 2018 had water that met primary drinking water standards due to elevated nitrate, mainly in South County domestic wells. If nitrate is not included, 100% of water supply wells met primary drinking water standards. **OM 2.1.1.f.** At least 90% of Coyote Valley and Llagas Subbasin wells meet Basin Plan agricultural objectives. **Measure met:** Nearly all wells (97%) had water that met agricultural objectives.
	Action Plan for OM 2.1.1.e: Implement Salt and Nutrient Management Plans to address nitrate, continue free domestic well testing and nitrate treatment system rebate programs, and continue collaborating with regulatory and land use agencies to address nitrate loading.
Groundwater Quality Trends	**OM 2.1.1.g.** At least 90% of wells in both the shallow and principal aquifer zones have stable or decreasing concentrations of nitrate, chloride, and Total Dissolved Solids. **Measure partially met:** This measure is not met for chloride, with 82% of wells having water with stable or decreasing concentration trends. The measure is met for nitrate and Total Dissolved Solids, with stable or decreasing concentrations observed in 91% and 92% of wells, respectively.
	Action Plan for OM 2.1.1.g: Implement Salt and Nutrient Management Plans to address salt loading, continue collaborating with regulatory and land use agencies.

As shown in Table 16, all outcome measures related to groundwater storage, levels, and land subsidence were met in 2018 due to healthy groundwater conditions that are fully recovered from the recent multi-year drought. The rapid recovery to pre-drought conditions demonstrates the effectiveness of significant investments in diverse water supplies and conjunctive water management, as well as close coordination with water retailers.

While most wells have stable or decreasing long-term chloride trends, increasing trends in a number of shallow aquifer wells warrant further evaluation. Valley Water will assess the potential cause, continue to implement the Salt and Nutrient Management Plans, and engage with regulatory and/or land use agencies as needed.

Elevated nitrate continues to be the primary groundwater protection challenge, particularly in South County. This condition is not unique to Santa Clara County as nitrate contamination is an issue in many agricultural or rural areas throughout the state. Long-term nitrate trends in Santa Clara County indicate stable or improving conditions, which is certainly preferable to worsening conditions. However, a significant number of South County wells (primarily domestic wells) still contain nitrate above the drinking water standard. Valley Water does not control land use or have regulatory authority over activities with the most nitrate loading to groundwater, such as irrigated agriculture or septic systems. However, Valley Water continues to coordinate with land use and regulatory agencies to influence policies, regulations, and decisions related to nitrate management. More directly, Valley Water's managed recharge programs help dilute nitrate in groundwater, and water quality testing and treatment system rebates help to reduce well owner exposure.

6.2 Status of Groundwater Management Plan Recommendations

As described in the Plan and demonstrated in this report, Valley Water's proactive groundwater management programs and activities have maintained sustainable groundwater levels and storage, minimized land subsidence, and improved groundwater protection. The Plan presents six major recommendations to maintain the long-term viability of groundwater resources. A summary of the status of each recommendation is below.

1. **Maintain existing conjunctive water management programs and evaluate opportunities for enhancement or increased efficiency.**

This Plan recommendation has several sub-recommendations, including items related to infrastructure reliability, high-priority capital project implementation, and securing imported water sources, among others. Valley Water continues to focus on extensive groundwater recharge through direct replenishment and in-lieu recharge. Updates relative to this Plan recommendation are presented below.

Capital Projects Supporting Conjunctive Management

Valley Water's Fiscal Year 2019-23 Five-Year Capital Improvement Program (CIP) was adopted by the Board on May 8, 2018.[39] With a significant portion of Valley Water's water supply infrastructure approaching fifty to sixty years of age, maintaining and upgrading the existing infrastructure to ensure each facility functions as intended for its useful life became the focus of the Water Supply CIP in recent years. Other CIP projects focus on expanding in-lieu and direct recharge through recycled and purified water projects. Major water supply capital improvements identified in the CIP include:

Storage:

- Almaden Dam Improvements
- Anderson Dam Seismic Retrofit
- Calero Dam Seismic Retrofit
- Guadalupe Dam Seismic Retrofit

Transmission:

- 10-Year Pipeline Rehabilitation

[39] The 2019-23 CIP is available at: https://www.valleywater.org/how-we-operate/five-year-capital-improvement-program

- Fisheries and Aquatic Habitat Collaborative Effort (FAHCE) Implementation
- Main and Madrone Pipeline Rehabilitation
- Vasona Pumping Plant Upgrade

Treatment:

- Penitencia Water Treatment Plant Residuals Management
- Rinconada Water Treatment Plant Reliability Improvement

Recycled Water:

- Expedited Purified Water Program
- South County Recycled Water Pipeline

Detailed information on each of these water supply capital projects, including related description, costs, and schedule, is available in the CIP.

California WaterFix[40]

On May 8, 2018, the Valley Water Board voted to participate in the California WaterFix project, the state's proposed plan to improve the infrastructure that carries water through the Sacramento-San Joaquin Delta. This vote is in line with the Board's Oct. 17, 2017 vote which offered conditional support to the project and asked that the state consider a lower-cost, scaled-down and phased project. Valley Water will continue to engage in and negotiate financial arrangements and agreements to ensure local interests are served and Santa Clara County benefits are achieved.

Pacheco Reservoir Expansion Project

In conjunction with the San Benito County Water District and Pacheco Pass Water District, Valley Water is exploring the possibility of expanding the existing Pacheco Reservoir on the North Fork Pacheco Creek in south-east Santa Clara County. The reservoir is located 60 miles southeast of San Jose and sits north of Highway 152. The project will increase the reservoir's capacity from 5,500 to up to 140,000-acre feet. The Pacheco Reservoir Expansion Project will provide a number of benefits, including: reducing the frequency and severity of water shortages, increased emergency water supplies, augment groundwater recharge, provide surface water instead of groundwater pumping, improved water quality, providing flood protection for disadvantaged communities, ecosystems benefit through our region and the Sacramento-San Joaquin Delta, and protecting and growing the native steelhead population. The Pacheco Reservoir Expansion Project has been conditionally awarded the full amount requested by Valley Water of $484.55 million from the Proposition 1 Water Storage Investment Program (WSIP) fund, which also includes an early funding award of $24.2 million.

2. **Continue to aggressively protect groundwater quality through Valley Water programs and collaboration with land use agencies, regulatory agencies, and basin stakeholders.**

Sub-recommendations from the Plan include continued groundwater quality monitoring, action when potentially adverse trends are identified, and continued/enhanced collaboration with local partners and stakeholders.

Groundwater quality is typically very good in the county, with no treatment beyond disinfection required at major retailer wells. However, nitrate remains an ongoing groundwater protection challenge, particularly in the more rural Coyote Valley and Llagas Subbasin. Valley Water continues to conduct extensive groundwater quality monitoring, evaluate long-term trends, and compare current conditions against regulatory standards and projected concentrations (such as from Salt and Nutrient Management Plans). Detailed information and analysis of all

[40] The project is now known as the Delta Conveyance Project and focuses on a single tunnel per direction from Governor Newsom.

monitoring data is presented in Valley Water's Annual Groundwater Report, which is calendar-year based and published each summer.[41]

Long-term trends are favorable for nitrate, with 90% of wells tested showing stable or decreasing concentrations. However, since a significant number of domestic wells in the Llagas Subbasin still contain nitrate above the drinking water standard, more work remains to be done. Valley Water offers rebates of up to $500 for nitrate treatment systems and will continue to engage with regulatory and land use agencies to address existing nitrate contamination. For nitrate and other water quality issues, Valley Water will work to build and enhance this collaboration to protect high-quality groundwater and expedite the restoration of impacted groundwater.

Valley Water is working with land use agencies on a Stormwater Resources Plan to increase infiltration while ensuring pollutants from urban runoff are not merely transmitted from surface water to groundwater. Similarly, Valley Water continues to engage with various entities to ensure that recycled water expansion or the use of purified water for recharge will be protective of groundwater quality.

Engaging with land use and regulatory agencies on proposed policy, legislation, and projects that may impact groundwater remains a key strategy for protecting groundwater. For example, Valley Water tracks the progress of major contaminant release sites, interacting with regulatory agencies to promote expedited and thorough cleanup. Valley Water also engages with land use agencies on relevant projects and policies such as development, stormwater infiltration devices, septic systems, and small water systems.

Public outreach continues to be an important component of Valley Water's groundwater protection efforts. In 2018, Valley Water celebrated Groundwater Awareness Week (March 11-17) by highlighting groundwater on the Valley Water website and posting related social media messages. Valley Water also maintained its status as a Groundwater Guardian through a program sponsored by the non-profit Groundwater Foundation. This is an annually earned designation for communities and affiliates that take voluntary, proactive steps toward groundwater protection.

To provide information on well sampling by Valley Water and local water suppliers, Valley Water prepared the 2018 Groundwater Quality Summary (Appendix B). This is similar to water retailer consumer confidence reports and provides basic groundwater quality information to domestic well owners who do not typically receive water from a water retailer.

Other groundwater-related public outreach conducted by Valley Water in 2018 included:

- Interaction with thousands of students through the Education Outreach program.
- Direct communication with well owners on groundwater quality, well maintenance, and treatment systems under the Domestic Well Testing and Nitrate Treatment System Rebate programs.

3. Continue to incorporate groundwater sustainability planning in Valley Water planning efforts.

This Plan recommendation focuses on continued, thoughtful water supply planning and investments. Valley Water is working to complete the Water Supply Master Plan 2040 to address future challenges to water supply reliability and implement related projects as appropriate. Staff has held multiple workshops with water retailers and stakeholders and presented information to the Board and various Board committees on numerous occasions. These presentations have included information on the proposed level of service target and potential water supply portfolios. All portfolios currently under consideration include the "No Regrets" package, which includes advanced metering infrastructure, leak repair incentives, expansion of our graywater program, a model ordinance for new

[41] The comprehensive Annual Groundwater Report for each calendar year is available at www.valleywater.org/groundwater.

developments, decentralized stormwater capture (e.g., incentives for rain barrels, cisterns, and rain gardens), and centralized stormwater capture (e.g., flooding of agricultural lands). Long-term water supply reliability is inextricably linked to groundwater sustainability due to the integrated management of groundwater and surface water in Santa Clara County.

Groundwater sustainability also remains an important element in the planning and implementation of multi-benefit projects under Valley Water's One Water Plan. The Sustainable Groundwater and Water Quality objectives of the One Water Plan align with the Plan outcome measures directly. The process to identify individual projects on the watershed scale (e.g., Coyote Watershed) within the One Water Plan also accounts for groundwater conditions and sustainability.

To support its managed response to climate change, Valley Water is scheduled to prepare a Climate Change Action Plan (CCAP) by the end of 2019. The CCAP will include comprehensive review of climate change as it relates to Valley Water core services and include actions Valley Water can take now and those it should continue to evaluate into the future. The CCAP will identify potential future climate change impacts, risks, and vulnerabilities on all core service areas, including water supply and groundwater management. Using this information, areas with potential impacts will be assessed to identify existing, enhanced, or new strategies to reduce risks to Valley Water core services and its mission. The strategies will be incorporated into existing Valley Water plans, budgets, and long-term financial forecasts as appropriate.

4. Maintain adequate monitoring programs and modeling tools.

This Plan recommendation focuses on improving monitoring networks by identifying and addressing gaps, redundancies, and access issues; identifying and implementing improvements to the numerical groundwater flow models; and improving Valley Water's understanding of surface water/groundwater interaction.

Valley Water continues to offer free basic well testing for domestic well owners to supplement regional groundwater quality monitoring, which emphasizes the use of consistent wells. Through this voluntary program, Valley Water obtains valuable data on nitrate and other contaminants while providing important water quality data to about 200 private well owners each year. Valley Water is evaluating the recycled water and recharge water quality monitoring networks to ensure they meet monitoring objectives in terms of frequency, locations, and constituents analyzed. Monthly Water Tracker[42] and groundwater condition reports[43] help keep stakeholders informed about current groundwater conditions including groundwater pumping, recharge, and water levels.

Valley Water uses three calibrated groundwater flow models – one for each groundwater management area (Santa Clara Plain, Coyote Valley, and the Llagas Subbasin). These models are used to evaluate groundwater storage and levels to inform operational decisions and long-term planning efforts. Staff is assessing each model to identify related improvements or enhancements that may be needed or desired to improve the use of these tools. Regarding surface water/groundwater interaction, Valley Water staff has begun to evaluate available data for stream gauging and groundwater levels, and whether existing wells adjacent to creeks may be useful in collecting additional data. Staff has attended workshops organized by DWR and reviewed both relevant literature and how other GSAs are working to better understand groundwater-surface water interaction. Staff has also performed preliminary experiments to measure the flux between surface water and groundwater. Valley Water will continue to explore the complex and dynamic interaction between surface water and groundwater and will engage

[42] https://www.valleywater.org/your-water/water-supply-planning/monthly-water-tracker
[43] https://www.valleywater.org/your-water/where-your-water-comes-from/groundwater/groundwater-monitoring

interested stakeholders. This issue will be further documented in the five-year Groundwater Management Plan update, which is due by January 2022.

5. Continue and enhance groundwater management partnerships with water retailers and land use agencies.

This Plan recommendation focuses on continued collaboration and strong partnerships with water retailers and land use agencies. Valley Water continues to interact regularly with water retailers through quarterly Water Retailer meetings, including the Groundwater Subcommittee. In addition to these regular meetings, Valley Water and water retailers collaborate on various issues that arise regarding groundwater, treated water, wells, and water measurement.

Valley Water also continues to coordinate with local land use agencies on General Plans, water supply assessments, Urban Water Management Plans, stormwater management, and various individual land use projects. Land use decisions fall under the authority of the local cities and the County of Santa Clara. Valley Water reviews land use and development plans related to Valley Water facilities and watercourses under Valley Water jurisdiction and provides technical review for other land use proposals as requested by the local agency. When provided by land use agencies, water supply assessments for new developments are also reviewed and evaluated in the context of Valley Water's long-term water supply plans. For all reviews, Valley Water's groundwater-related comments focus on potential impacts to groundwater quality and sustainability.

6. Evaluate the potential new authorities provided by SGMA.

The Santa Clara Valley Water District Act provides broad authorities, but there are additional authorities under SGMA including the ability to regulate pumping or impose various types of fees. This Plan recommendation focused on the evaluation of these new SGMA authorities in cooperation with water retailers and other interested stakeholders to consider what conditions might necessitate their implementation to sustainably manage groundwater into the future.

Throughout 2017, Valley Water explored new SGMA authorities with interested stakeholders through the open forum of the Board's Water Conservation and Demand Management Committee (Committee). The potential regulation of pumping or well construction, a complex and controversial topic, was discussed extensively. Existing groundwater management programs and strong partnerships with large pumpers are expected to result in continued sustainable conditions and are the preferred way to address future challenges. However, pumping regulation may be needed in the future to address undesirable results. Through the Committee, the fundamental approach to regulate groundwater pumping (if needed) was identified to provide some certainty on the process while avoiding prescriptive requirements. This process was memorialized via a resolution adopted by Valley Water Board on February 27, 2018.

Valley Water also explored the potential to implement a fixed charge as a component of groundwater production charges, which are currently volumetric charges. This could potentially reduce volatility in rates and revenues based on changes in water use. Valley Water engaged a consultant to develop a fixed charge proposal and assist with implementation. However, major water retailers expressed significant concerns, including redundancy with other charges or charge adjustment mechanisms, equity in applying the charge to all well users, and potential cost recovery impacts to retailers regulated by the California Public Utilities Commission. After discussing these concerns with the Committee and the full Board, Valley Water is unlikely to further pursue a fixed charge at this time.

6.3 Status of Sustainable Groundwater Management Act Compliance

In December 2016, Valley Water submitted the Plan (for the Santa Clara and Llagas subbasins) to DWR as an Alternative to a Groundwater Sustainability Plan (GSP). In July 2019, DWR issued an assessment, finding the Valley Water Plan satisfies the objectives of SGMA and is an acceptable Alternative. Valley Water will be required to submit an updated Plan every five years, with the next Plan due by January 1, 2022.

Once an Alternative or GSP is submitted, SGMA requires that specific information on groundwater use, levels, and storage be reported annually by April 1 for the previous water year. In March 2019, Valley Water submitted the second annual report required by SGMA (Appendix F). Because most Valley Water planning efforts are based on the calendar year, this Annual Groundwater Report presents some of the same information based on the calendar year. It also provides more detailed information on groundwater conditions, particularly regarding groundwater quality.

Valley Water is also the GSA for the small portions of the North San Benito Subbasin within Santa Clara County.[44] As such, staff is supporting efforts led by the San Benito County Water District[45] to develop a GSP by the statutory deadline of January 2022. This includes serving on the Technical Advisory Committee, sharing relevant data, and other coordination as needed.

Continued groundwater sustainability is central to the Valley Water mission to provide Silicon Valley safe, clean water for a healthy life, environment, and economy. As such, Valley Water will continue to "aggressively protect groundwater from the threat of contamination and maintain and develop groundwater to optimize reliability and to minimize land subsidence and salt water intrusion," in accordance with Board policy. Valley Water's approach to groundwater management has evolved over many decades to address numerous challenges, and this adaptive approach will help ensure continued sustainability.

[44] A basin boundary modification was approved by DWR in 2019 to consolidate four subbasins primarily located in San Benito County. These include the Hollister and San Juan Bautista Area subbasins, which extend into Santa Clara County.
[45] The GSA for the portions of the North San Benito Subbasin located in San Benito County.

Appendix A

2018 Subsidence Data Analysis Report

Valley Water

TECHNICAL MEMORANDUM

2018 SUBSIDENCE DATA ANALYSIS

Prepared by:

Yaping Liu, Ph.D., P.E.
Associate Civil Engineer

Under the Direction of:

Vanessa De La Piedra, P.E.
Unit Manager

Santa Clara Valley Water District
Groundwater Management Unit

March 2019

This page is intentionally left blank.

EXECUTIVE SUMMARY

This technical memo presents land subsidence data analysis for calendar year 2018. Throughout the first two thirds of the 20th century, land subsidence occurred in the Santa Clara Plain in northern Santa Clara County mainly due to groundwater overdraft causing declining groundwater elevations and pressures. Permanent (inelastic) subsidence was essentially halted in the early 1970s through the Santa Clara Valley Water District's (Valley Water's) conjunctive management programs and investments (SCVWD, 2017). None-the-less, monitoring continues and is critical to Valley Water in fulfilling its mission of minimizing land subsidence and salt water intrusion (Board Ends Policy 2.1.1). Monitoring provides data to evaluate current conditions and for early detection of the potential resumption of permanent subsidence. Annually, Valley Water analyzes land subsidence monitoring data, evaluates subsidence conditions, and recommends improvements to the subsidence monitoring network. Data collected from 2008 to 2018 is used in this analysis.

2018 annual precipitation was 11.02 inches, in comparison to the average annual precipitation of 14.5 inches, in the Santa Clara Plain. The annual groundwater pumping in 2018 was 63,600 acre-feet (AF). 2018 total groundwater recharge was 96,300 AF, of which 76,500 AF was managed recharge and 19,800 AF was natural recharge. Since total recharge exceeded pumping, the overall groundwater elevation increased in the Santa Clara Plain in 2018.

The data measured in 2018 through Valley Water's subsidence monitoring network, which includes benchmarks, extensometers, and subsidence index wells, shows the following:

- Aquifer expansion was measured at Valley Water's two extensometer sites in 2018. The average annual subsidence rate over the last 11 years at the San Jose (Martha) and Sunnyvale (Sunny) sites is -0.005 feet/year (aquifer expansion), which meets Valley Water's established tolerable subsidence rate of not more than 0.01 feet/year.
- The 2018 annual average of groundwater elevations showed little change from 2017 levels, close to or at historically high levels. The groundwater elevations were above subsidence thresholds at all ten index wells for the entire year.
- The elevation benchmark survey data showed that the land surface elevations in 2018 were generally higher than 2017 at most benchmarks, indicating little land subsidence potential existed. The average annual change of land surface elevations of all benchmarks over the last 11 years was zero.

The analysis of the data collected through Valley Water's subsidence monitoring network indicates that the risk of land subsidence in 2018 was very low and was less than 2017. Monitoring of the subsidence network will continue as it is needed to detect early signs of permanent land subsidence and to ensure a sustainable groundwater supply.

BACKGROUND

The Santa Clara Plain is a groundwater management area occupying the northwestern and largest part of the Santa Clara Subbasin. The Santa Clara Plain extends from Santa Clara County's northern boundary to approximately Metcalf Road in the Coyote Valley and is bounded on the west by the Santa Cruz Mountains and the east by the Diablo Range (Figure 1). Land subsidence has caused serious problems in the past in the Santa Clara Plain: nearly 13 feet of permanent subsidence occurred in downtown San

Jose and more than a foot of permanent subsidence occurred over the surrounding hundred square miles.

Ongoing monitoring provides data for current land subsidence evaluation and early detection of potential inelastic subsidence. The Valley Water land subsidence monitoring network (Figure 1) includes:

- Two extensometers: one in Sunnyvale (Sunny) and one in San Jose (Martha), monitored continuously by telemetry systems;
- Around 140 elevation benchmarks along three Cross Valley Level Circuits (CVLCs), which are surveyed in the fall of every year; and
- Ten subsidence index wells with groundwater elevations monitored at least monthly.

EVALUATION

Figure 1 shows a map of the Valley Water subsidence monitoring network in the Santa Clara Plain. Two extensometers are in the confined area of the Santa Clara Plain. Benchmarks are grouped into three CVLCs: Guadalupe (northwest-trending circuit along the axis of the valley), Los Altos (west-east trending circuit to the north), and Alum Rock circuit (west-east trending circuit to the south). The ten subsidence index wells are located throughout the Santa Clara Plain.

Groundwater elevation analysis

Groundwater elevation monitoring is an integral part of the land subsidence monitoring program since the decrease in water elevation is the driving force of land subsidence in the Santa Clara Plain. The current frequency of groundwater elevation monitoring at subsidence index wells varies from daily to monthly. Water elevation hydrographs at the ten index wells are presented in Figure 2, along with the subsidence groundwater elevation thresholds determined for each well (GEOSCIENCE, 1991). The North American Vertical Datum of 1988 (NAVD88) is used for the groundwater elevation values in this document.

A subsidence threshold is a recommended groundwater elevation; maintaining groundwater at elevations near or below the threshold for extended periods of time increases the risk of subsidence resumption and potential damage to facilities and infrastructures. Historically, land subsidence was observed mainly in the confined area of the Santa Clara Plain. Accordingly, most index wells (eight out of ten) are in or near the confined area. Valley Water's groundwater management goal is to maintain groundwater elevations in the Santa Clara Plain above subsidence thresholds to minimize the risk of resuming permanent land subsidence.

Historical low water elevations at most wells in Santa Clara Plain were observed in the 1960s and 1970s. Since then, the groundwater elevations have been generally in recovery due to the importation of surface water from the Delta and related increased managed recharge and/or reduced groundwater pumping. During the recent drought, groundwater elevations in the Santa Clara Plain had been generally declining starting in 2012 and reached recent low water elevations in 2014. In 2014, groundwater elevations at three subsidence index wells (well numbers ending in 07S01W22E002, 07S01E16C006, and 07S01W02G024) were close to or below subsidence thresholds, causing concerns about an increased risk of land subsidence. This prompted an aggressive response that included increased calls for water use reduction, requests for water retailers to use more treated water instead of pumping, the acquisition of supplemental supplies, and enhanced water conservation rebates.

The annual precipitation from 2016 to 2018 was close to or above the normal after four years of below-normal rainfall from 2012 to 2015. The average groundwater elevations rose in 2016 and 2017 and remained high in 2018 at all subsidence index wells. Groundwater elevations at the end of 2018 were well above subsidence thresholds. The main driver of the water elevation recovery from 2016 to 2018 was the reduced pumping and increased recharge. The total recharge amount, including the managed recharge and natural recharge, was about 1.7 times the pumping on a three-year average for 2016 to 2018. This resulted in the water elevations at end of 2018 being 13 to 130 feet higher than the lowest water elevations in 2014 in subsidence index wells.

It is critical to manage the groundwater basin in a manner that maintains a groundwater gradient towards the San Francisco Bay to keep salt water from entering groundwater aquifer. There are three index wells along the bay front: 06S02W22G005, 06S02W24C010, and 06S01W24H015. During the recent drought, groundwater elevations in those three wells declined consistently, reaching their recent low elevations in 2014. As described above, a significant water elevation recovery has been observed since then. By the end of 2018, all three bay front index wells had strong artesian pressure, with the piezometric surface above the land surface, which reduces the risk of salt water intrusion.

In summary, groundwater elevations measured at subsidence index wells were maintained above subsidence thresholds throughout 2018. Measured groundwater elevations indicate that the risk of both land subsidence resumption and salt water intrusion was very low, significantly reduced in comparison to 2014 during the height of the drought.

Extensometer data analysis

Daily compaction/expansion data measured at two extensometers and depth to water (DTW) measured at or near the extensometers were used for this analysis. An extensometer is a device used to continuously monitor aquifer compaction (land subsidence) and expansion (land uplift). The extensometers were installed in the early 1960s in Sunnyvale (Sunny) and San Jose (Martha) to measure the compaction or expansion of the first 1,000 feet of the aquifer system. The extensometer sites were selected in areas with high land subsidence between the 1930s and 1960s. These areas were also pumping centers during that period. The Valley Water target is that the average value of subsidence measured at these two sites over the last 11 years does not exceed the tolerable subsidence rate of 0.01 feet/year (GEOSCIENCE, 1991).

Long- term data: Permanent (inelastic) subsidence was essentially halted in the early 1970s. Figures 3 and 4 present the cumulative aquifer compaction/expansion and DTW from 1970 to 2018 for the Sunny and Martha extensometers, respectively. There are some differences in compaction/expansion and groundwater elevation conditions at the two sites during this period: (1) the aquifer compaction change at Sunny is relatively small when comparing to that at Martha (2) the groundwater elevation at Sunny has been above the land surface (negative DTW) since 1993, while the groundwater elevation at Martha has consistently been below the land surface (positive DTW); and (3) the seasonal water elevation change at Sunny is relatively small when compared to that at Martha. Those differences indicate that the pumping activity and scale at Sunny is less than that at Martha, which is in the middle of a wellfield.

Current conditions: Measured extensometer data is used to evaluate current land subsidence conditions. Table 1 shows measured annual subsidence from 2008 to 2018 and the calculated 11-year average at Sunny and Martha. The 11-year average of annual subsidence rate is -0.005 feet/year; the negative value of extensometer data indicates aquifer expansion (or land uplift). This value meets the

Valley Water tolerable subsidence rate goal of not exceeding 0.01 feet/year. Comparing to the value reported in 2017 Subsidence Data Analysis Technical Memorandum, the 11-year average value changed from 0.001 feet/year in 2017 to -0.005 feet/year in 2018, net average uplift of 0.006 feet/year.

Table 1. Measured annual land subsidence at the Sunnyvale (Sunny) and San Jose (Martha) extensometers from 2008 to 2018

Year	Sunny (feet/year)	Martha (feet/year)	Average at Two Sites (feet/year)
2008	0.012	0.019	0.016
2009	0.008	-0.020	-0.006
2010	-0.025	-0.024	-0.025
2011	-0.009	-0.032	-0.021
2012	-0.014	0.013	-0.001
2013	0.026	0.064	0.045
2014	0.049	0.053	0.051
2015	-0.022	-0.021	-0.022
2016	-0.025	-0.087	-0.056
2017	-0.018	-0.007	-0.013
2018	-0.013	-0.020	-0.017
Average from 2008 – 2018	-0.003	-0.006	**-0.005**

Note: A positive value indicates compaction (subsidence) while a negative value indicates expansion (uplift).

Stress-strain analysis: A stress-strain diagram plots DTW against compaction/expansion, allowing for analysis of seasonal, annual, or multi-year land subsidence. Strain increases with stress. Since a typical groundwater hydrograph in the Santa Clara Plain shows annual high groundwater elevations (or low DTW) in the spring, the corresponding subsidence is low in spring. A stress-strain diagram from one spring to the next shows an annual cycle in which the strain usually increases from the spring to the fall and then decreases from the fall to the next spring.

Figures 5 and 6 present the stress-strain diagrams using measured data from spring 2017 to spring 2018 at the Sunny and Martha extensometers, respectively. These diagrams demonstrate that the stress and strain in spring 2018 are lower than in spring 2017 at both locations, which means the increased strain from spring to fall 2017 was fully recovered or a net aquifer expansion was observed from spring 2017 to spring 2018. These diagrams also show that the stress decreased (or water levels increased) from spring 2017 to spring 2018, especially at Martha site. This trend is consistent with measured water levels at subsidence index wells. Net aquifer expansion was observed from end of year (EOY) 2017 to EOY 2018 at both the Sunny and Martha extensometers sites.

Benchmark survey data analysis

The benchmark survey data along the Los Altos, Alum Rock, and Guadalupe CVLCs are used to study spatial land subsidence conditions and annual changes throughout the Santa Clara Plain. The benchmark survey is conducted in the fall of each year. Figure 1 shows benchmark locations along the three CVLCs surveyed in 2018. Related analysis is summarized below.

Change in land surface elevation from 2017 to 2018: As discussed above, 2018 groundwater elevations remained relatively high throughout the Santa Clara Plain. Figure 7 shows the annual change in land surface elevation from 2017 to 2018 at benchmarks along the Los Altos, Alum Rock, and Guadalupe circuits. For benchmark survey data, a positive value indicates an increase in land surface elevation (uplift) and a negative value indicates a decrease (subsidence); this is the opposite of the extensometer data.

2018 survey data showed a trend of positive land surface elevation changes from 2017 at the majority of benchmarks, except the west portion of Los Altos circuit where some land subsidence was observed. Table 2 summarizes the average and range of annual change of land surface elevation from 2017 to 2018. The average annual change of land surface elevation in 2018 is positive, indicating uplift in general. The risk of land subsidence of 2018 was lower than 2017.

Table 2. Fall 2018 change in land surface elevation compared to fall 2017

Survey Circuit	Average	Range	Number of Benchmarks
	(ft)	(ft)	
Los Altos	-0.01	-0.05 to 0.03	39
Alum Rock	0.01	-0.01 to 0.04	52
Guadalupe	0.04	0.00 to 0.07	50

Note: A positive value indicates an increase in land surface elevation (uplift) and a negative value indicates a decrease (subsidence).

Long-term change in land surface elevation: The average annual change of land surface elevation in the last 11 years from 2008 to 2018 at individual benchmarks is presented in Figure 8. Although there were larger changes in some years at individual benchmarks, the average annual change at most benchmarks was within the range of -0.01 to 0.01 feet/year. Figure 9 shows the average annual change of land surface elevation at all benchmarks in the last 11 years from 2008 to 2018. During this 11-year period, there were seven years with positive values (uplift) and four years with negative values (subsidence). The highest annual subsidence was in 2014 and highest annual uplift was in 2016. The average annual ground surface elevation change for all benchmarks over the last eleven years for is around 0.00 feet, indicating no net change.

In summary, the benchmark survey data show a land surface uplift at most benchmarks along the three CVLCs corresponding with rebounding groundwater elevations in 2018. The risk of land subsidence of 2018 was very low and was lower than 2017. The average annual change of land surface elevation in the last 11 years at all benchmarks is 0.00 feet, which corroborates the extensometer data.

Discussion

As shown in Figure 1, the current land subsidence monitoring network consists of two extensometers, 141 benchmarks along three CVLCs, and ten subsidence groundwater monitoring wells, covering most of the Santa Clara Plain. The extensometers monitor subsidence conditions at two sites with compaction and water elevation data. The annual survey provides data representing the subsidence condition at benchmarks along three CVLCs. The monitoring of water elevations at subsidence index wells does not provide data to quantify the subsidence condition directly, but the monitoring is straightforward and

related data can be used as an indicator for subsidence condition. Since the index wells are located throughout the Santa Clara Plain, the monitoring data reflects regional conditions.

The current Valley Water practice of evaluating the land subsidence condition in the Santa Clara Plain is to calculate the average over an 11-year period using subsidence data collected at two extensometers (Sunny and Martha) and compare it with the established, tolerable rate of land subsidence. The tolerable subsidence rate of 0.01 feet/year is based on the arithmetic average of historic subsidence and rebound measured in the Sunny and Martha extensometers for the 11-year period from 1980 to 1990 (GEOSCIENCE, 1991). Re-evaluation of the tolerable subsidence rate may be warranted to ensure the rate remains aligned with local groundwater management goals.

The subsidence thresholds established at ten index wells are used as the minimum water elevations that should be maintained to avoid further permanent land subsidence. Although the thresholds were established more than twenty years ago, they were based on a thorough study of historical data, subsidence modeling, and previous studies. It is recommended to continue to use these thresholds for groundwater management and early indication of potential concerns. Because these thresholds are based on the 0.01 feet/year tolerable subsidence rate, they should be re-evaluated if the tolerable subsidence rate changes or if other information indicates a change is warranted.

The annual survey at benchmarks provides direct measurement of land surface changes along three CVLCs in the Santa Clara Plain. However, there are no established criteria to evaluate the survey data.

CONCLUSIONS

In summary, the data measured by each component of the subsidence monitoring network shows that:

- Aquifer expansion (or uplift) was measured at both extensometer sites in 2018. The average annual subsidence rate over the last 11 years at the Martha and Sunny sites is -0.005 feet/year, which meets Valley Water's tolerable rate of 0.01 feet/year.
- The average water elevations in 2018 had little change from 2017 at all ten subsidence index wells. In general, 2018 water elevations were close to or at historical high levels throughout the Santa Clara Plain. Groundwater elevations were higher than the subsidence thresholds at all ten index wells in 2018 in the Santa Clara Plain.
- The benchmark survey data showed that the land surface elevation in 2018 was generally higher than 2017, indicating a land uplift, and that the average annual change of land surface elevation over last 11 years was 0.00 feet (no net change).

The analysis of the data collected through the Valley Water subsidence monitoring network indicates that the risk of land subsidence in 2018 was very low and that it was lower than 2017. Continued monitoring of the subsidence network is recommended to detect early signs of inelastic land subsidence and to support sustainable groundwater supply.

REFERENCES

1. GEOSCIENCE Support Services Incorporated, Subsidence Threshold in the North County Area of Santa Clara Valley, 1991.
2. Santa Clara Valley Water District (SCVWD), 2016 Groundwater Management Plan for the Santa Clara and Llagas Subbasins, December 2016.
3. SCVWD, 2017 Subsidence Data Analysis, Technical Memorandum, March 2018.

Figure 1. Map of the Valley Water subsidence monitoring network

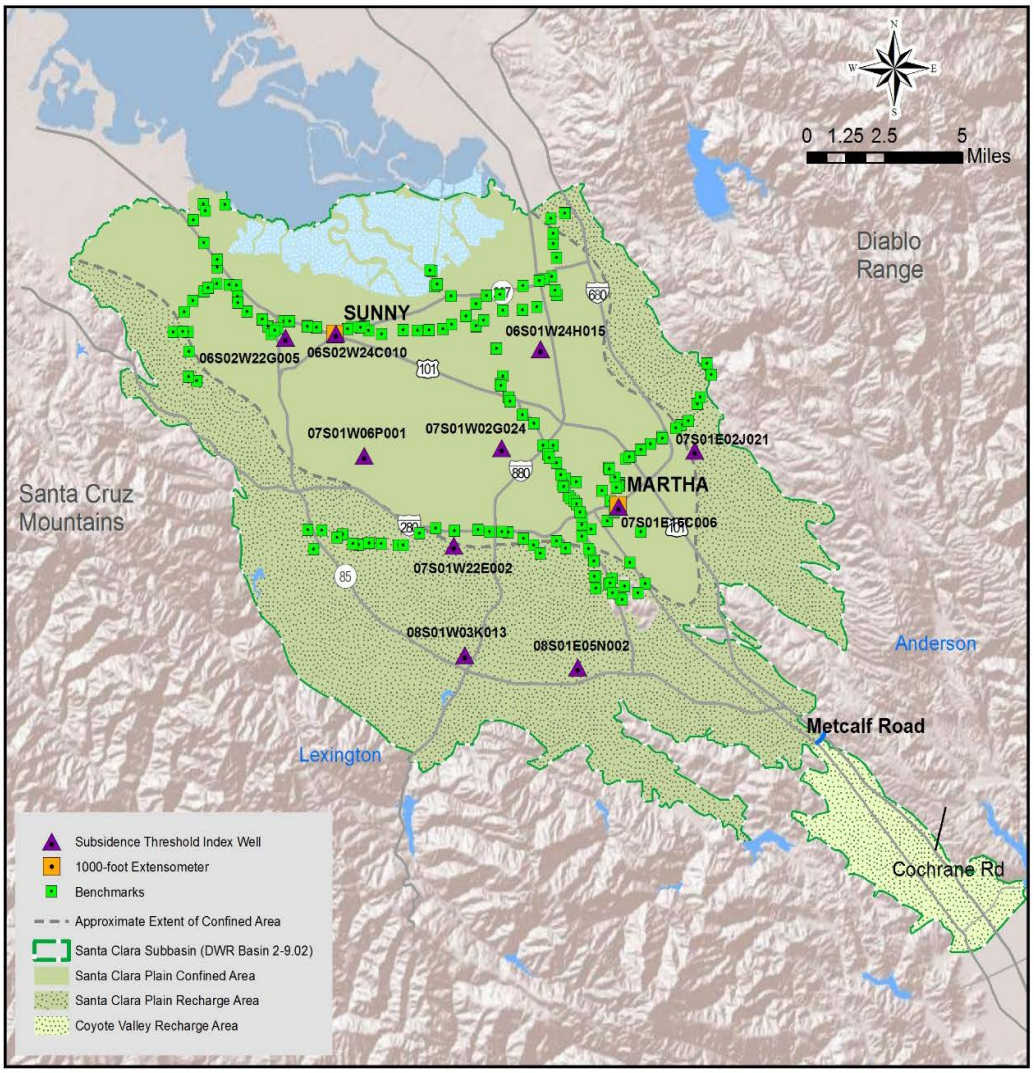
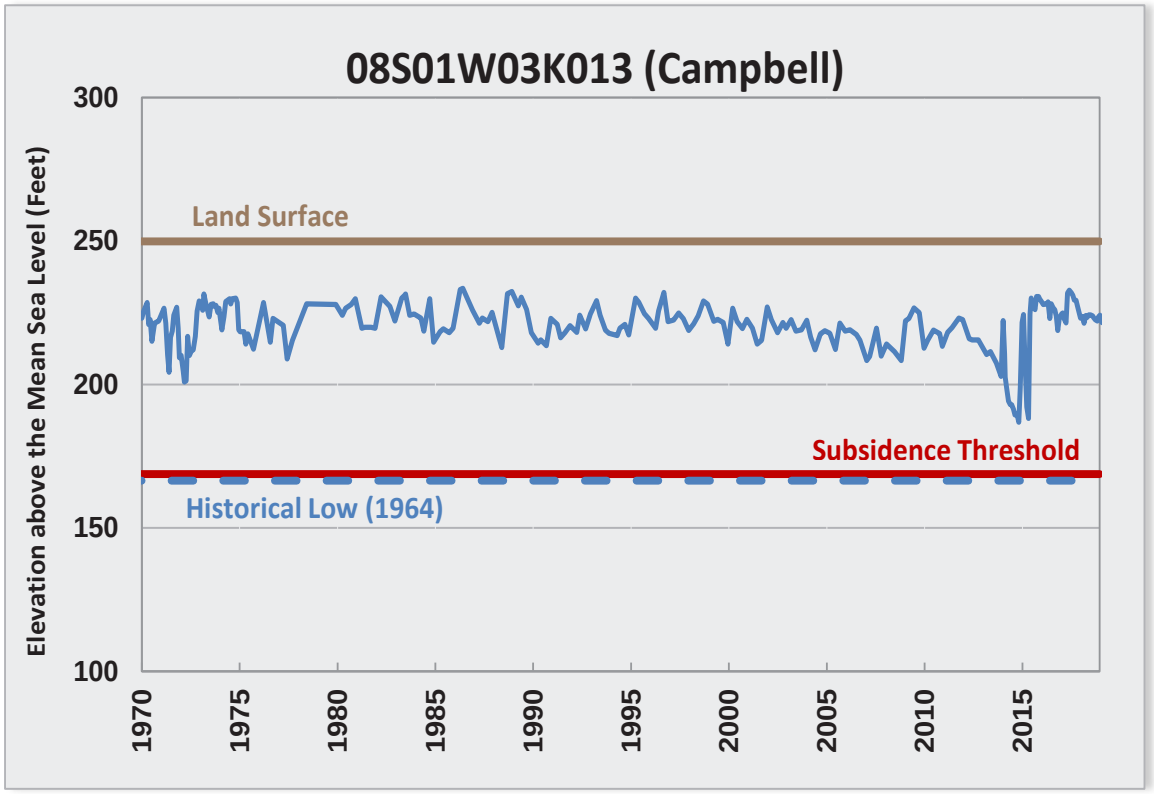


Figure 2. **Measured groundwater elevation at subsidence index wells**



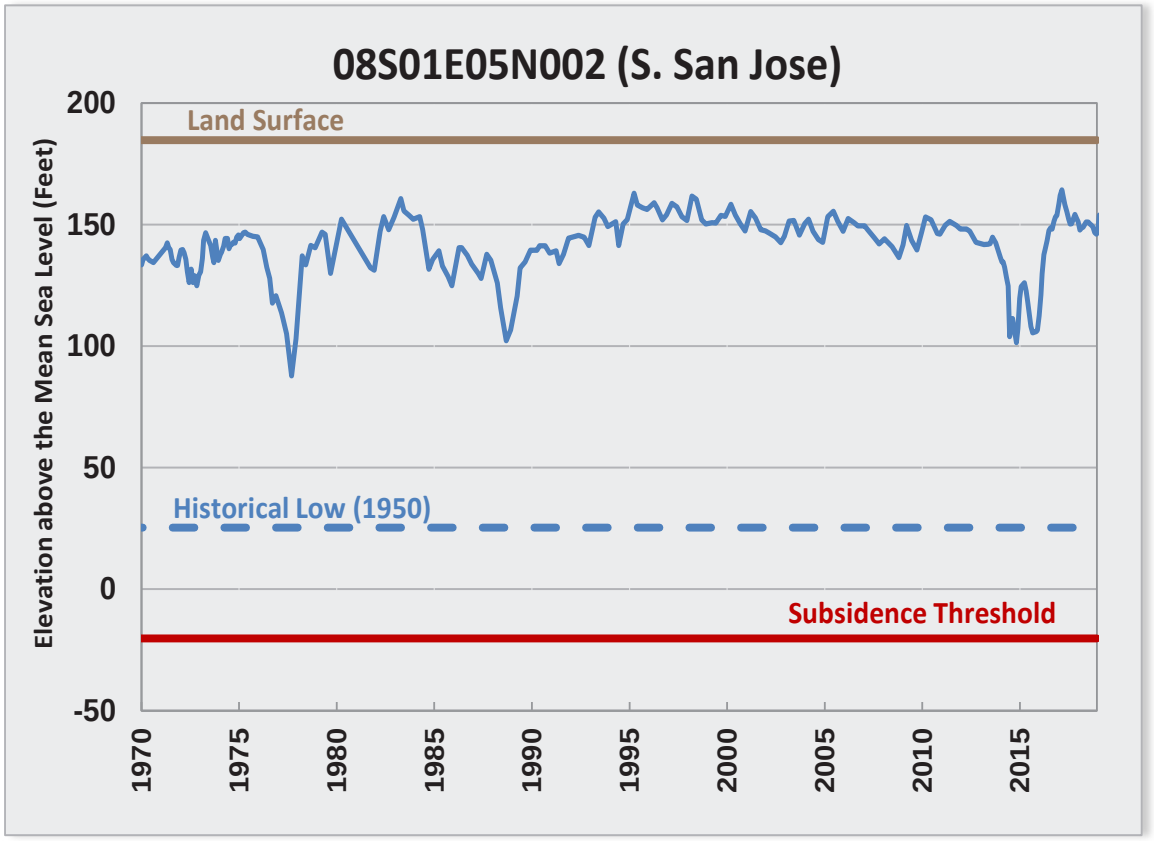
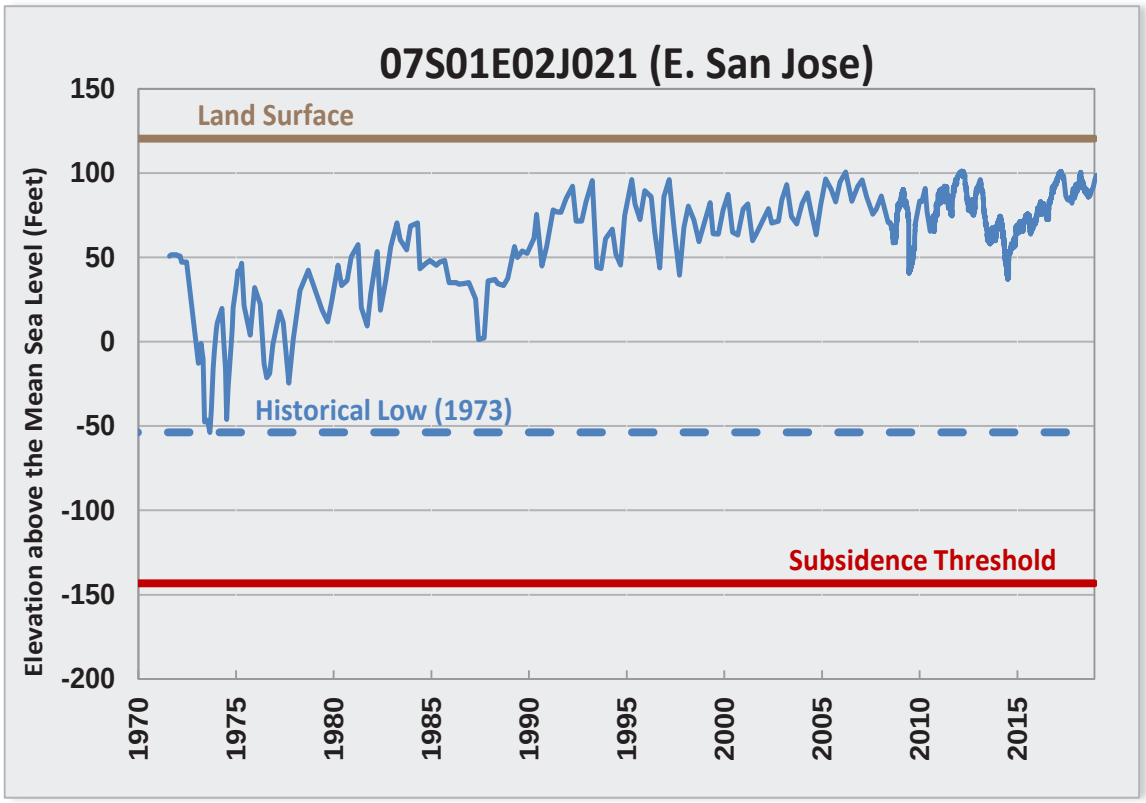


Figure 2. Measured groundwater elevation at subsidence index wells (continued)



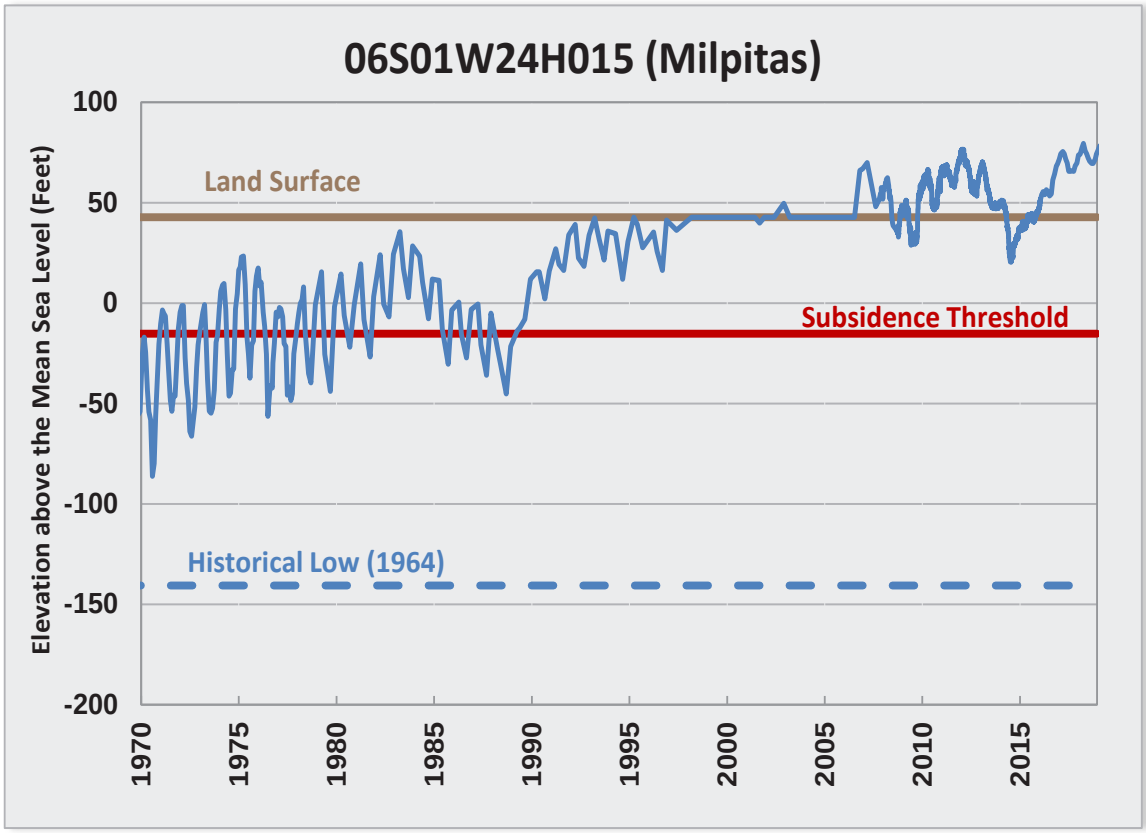
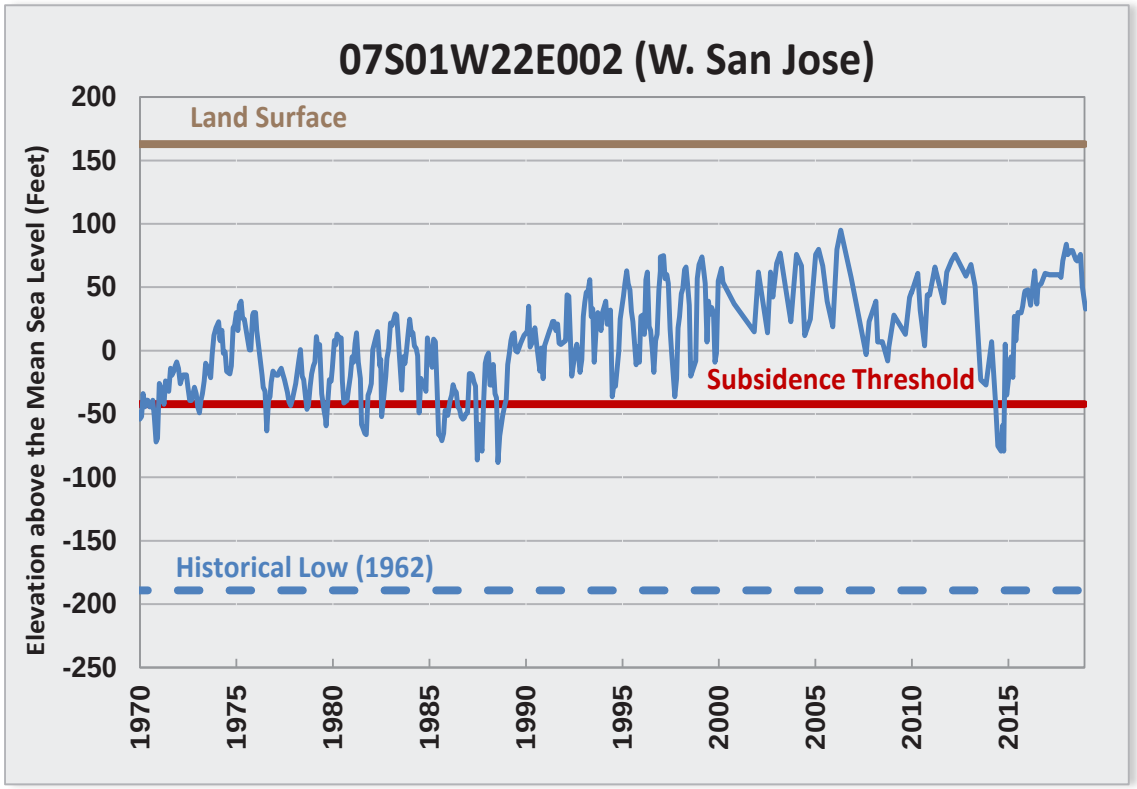


Figure 2. **Measured groundwater elevation at subsidence index wells (continued)**



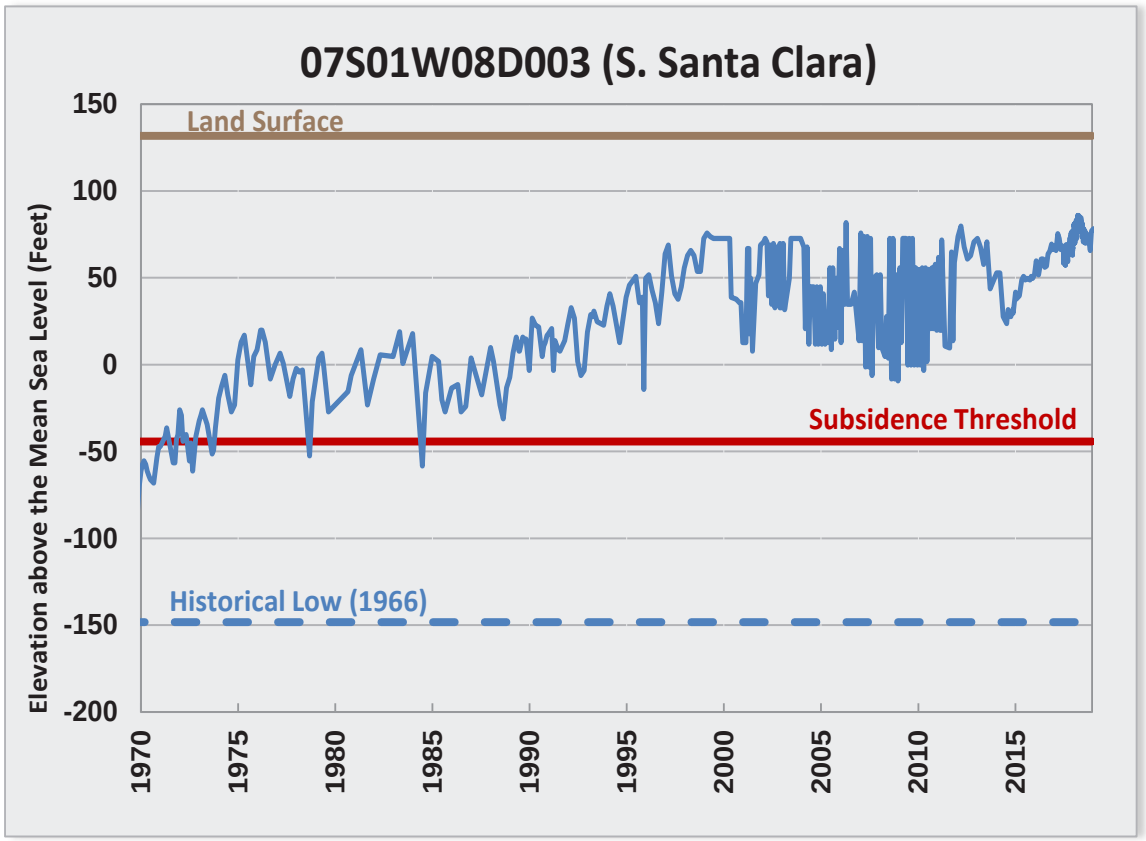
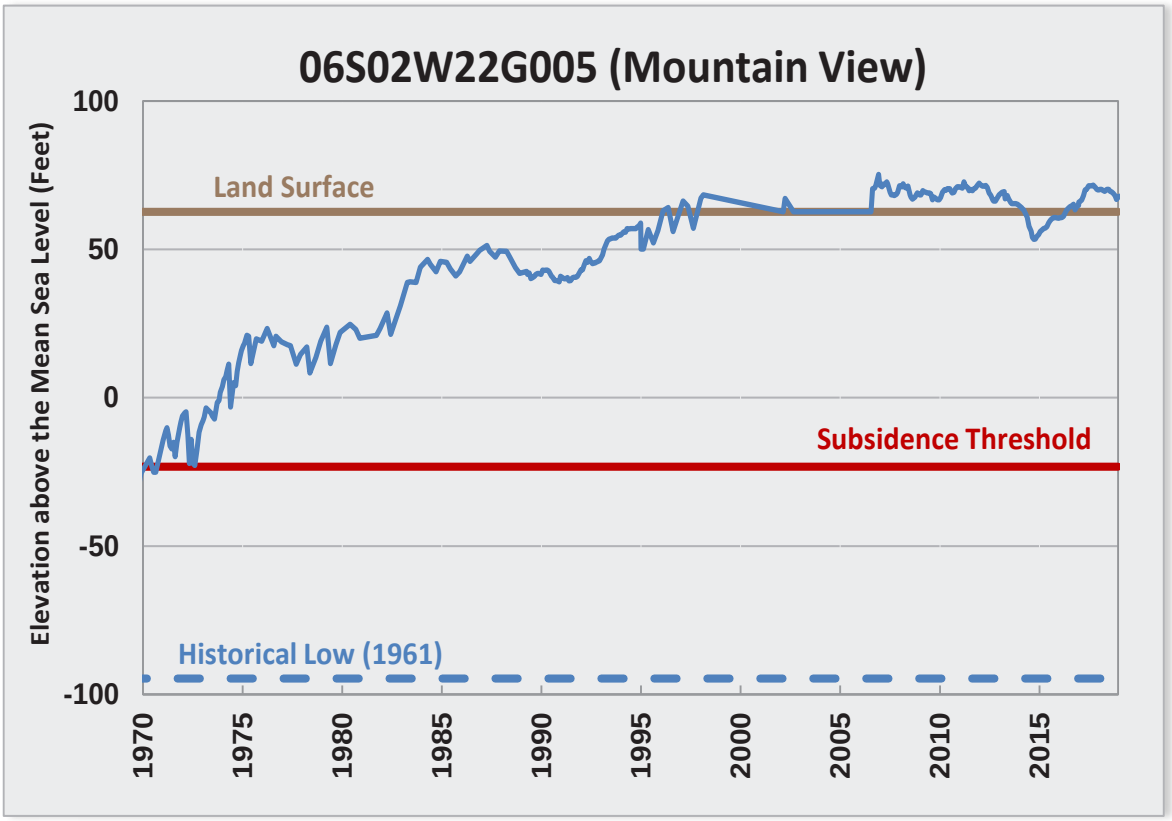


Figure 2. Measured groundwater elevation at subsidence index wells (continued)



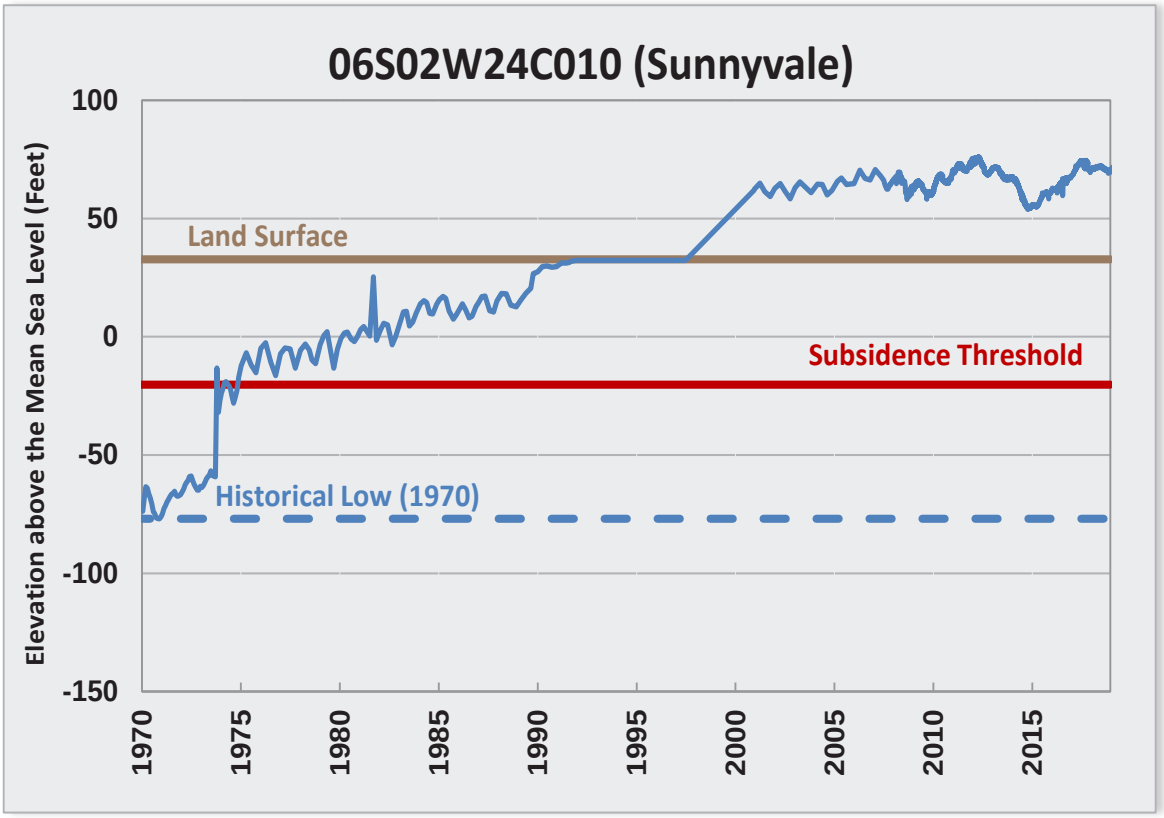
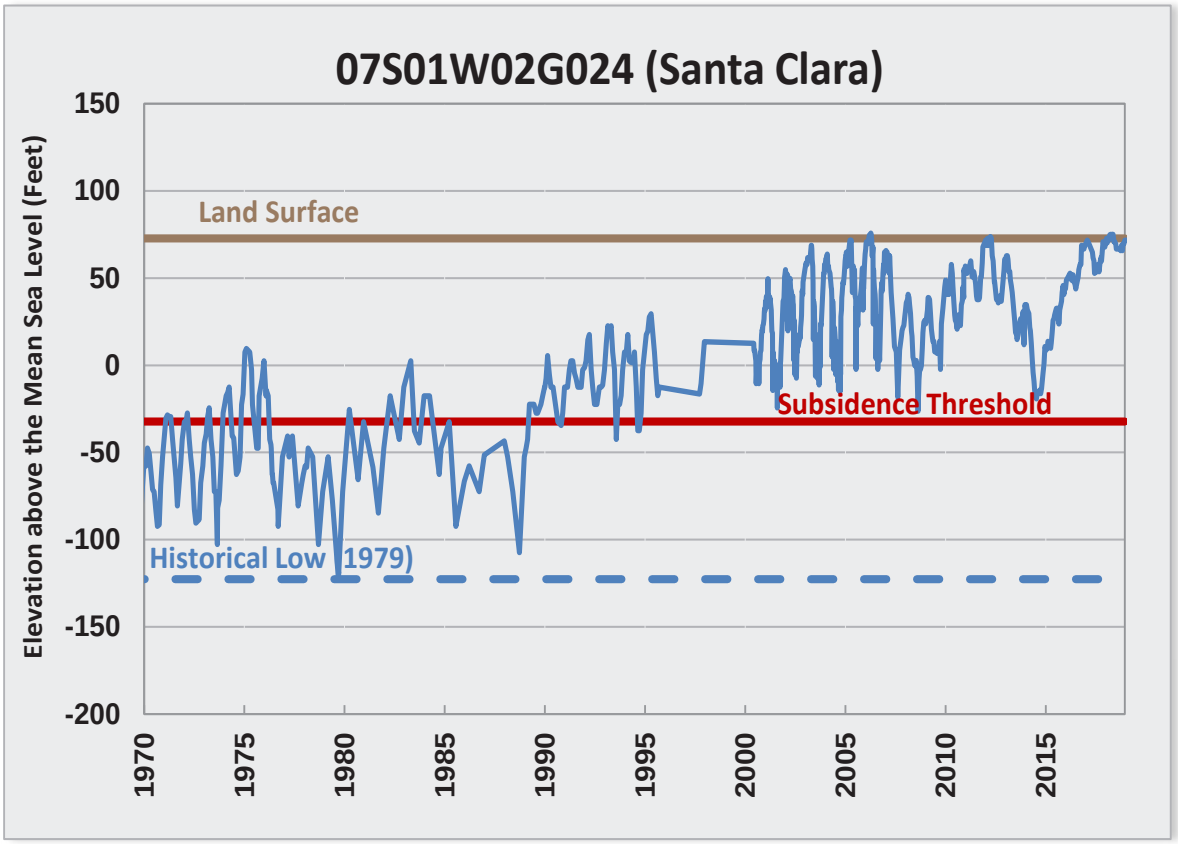


Figure 2. **Measured groundwater elevation at subsidence index wells (continued)**



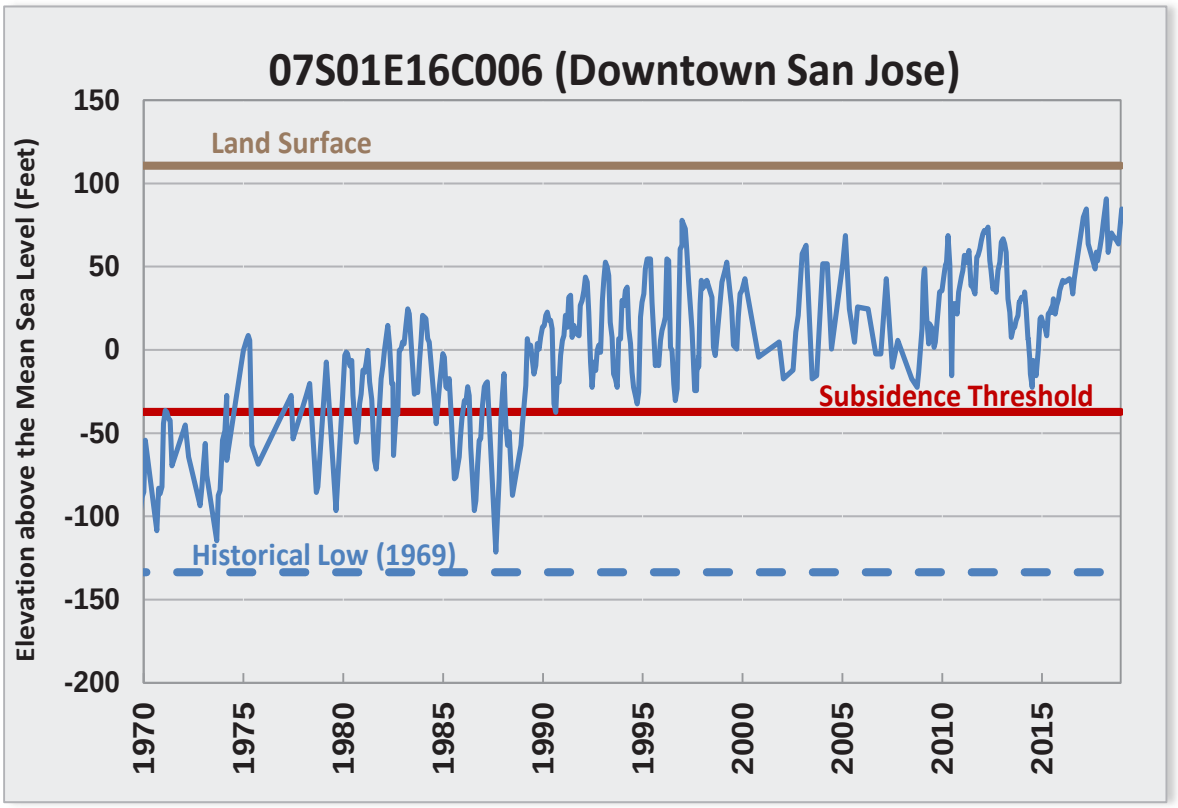


Figure 3. Measured depth to water and compaction at the Sunnyvale (Sunny) extensometer

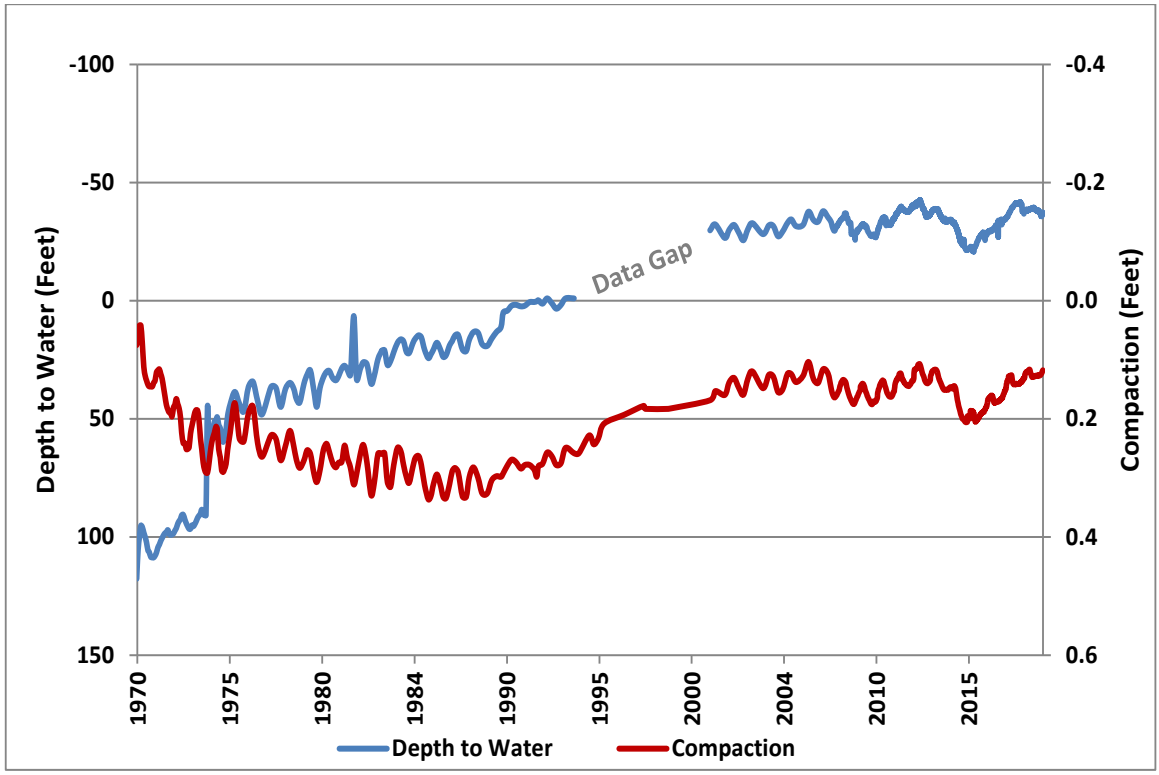


Figure 4. Measured depth to water and compaction at the San Jose (Martha) extensometer

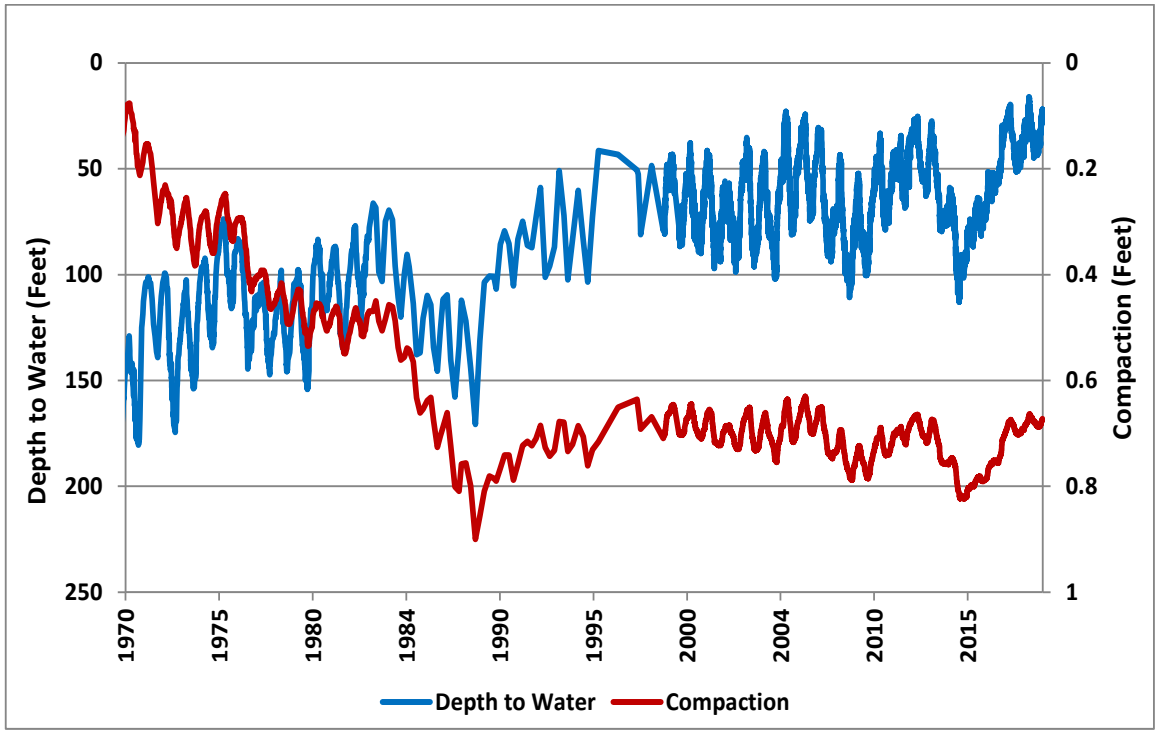


Figure 5. **Stress-strain (depth to water vs. compaction) from spring 2017 to spring 2018 at the Sunnyvale (Sunny) extensometer**

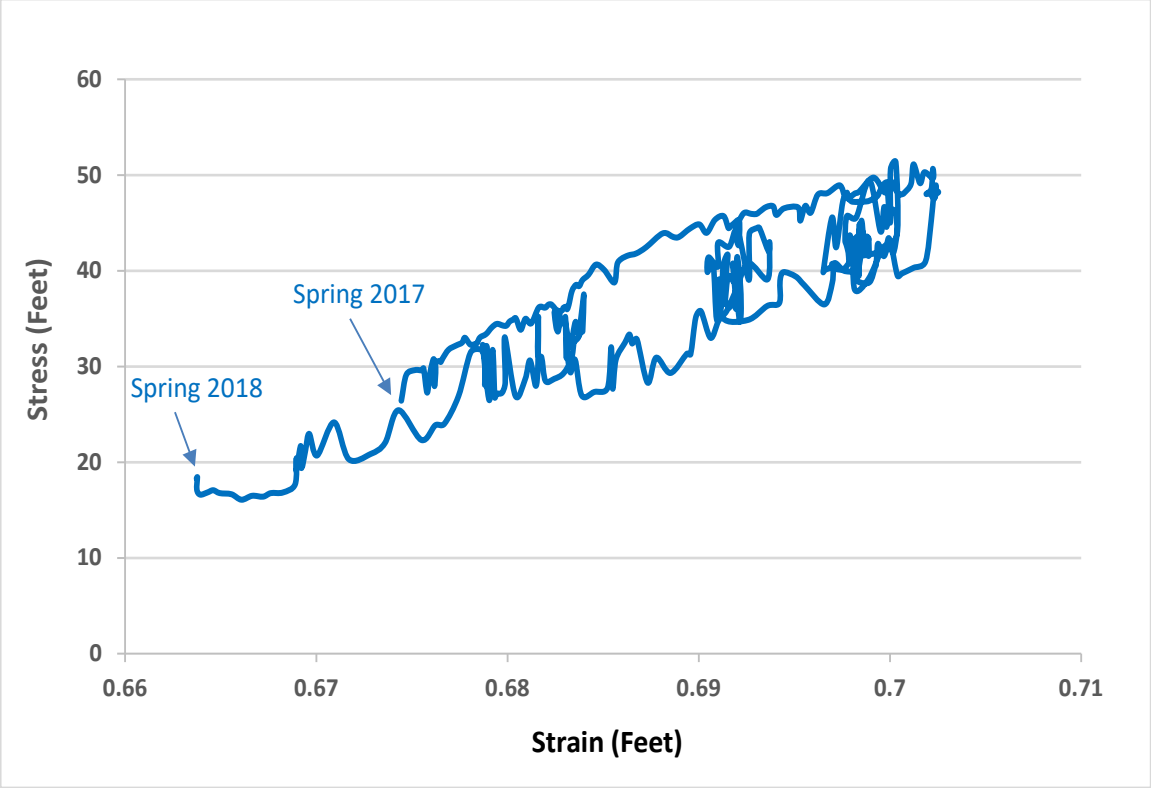


Figure 6 **Stress-strain (depth vs. compaction) from spring 2017 to spring 2018 at the San Jose (Martha) extensometer**

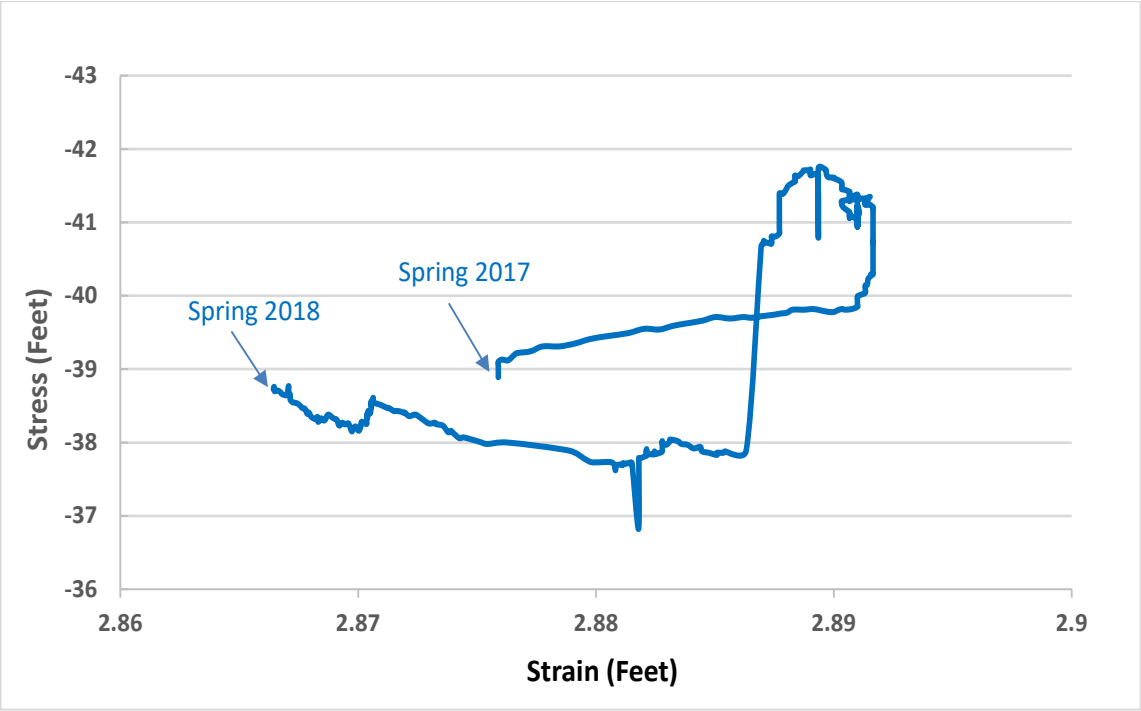


Figure 7. **Annual change of land surface elevations from 2017 to 2018 along the three benchmark circuits (shown from west to east for Los Altos and Alum Rock, and north to south for Guadalupe)**

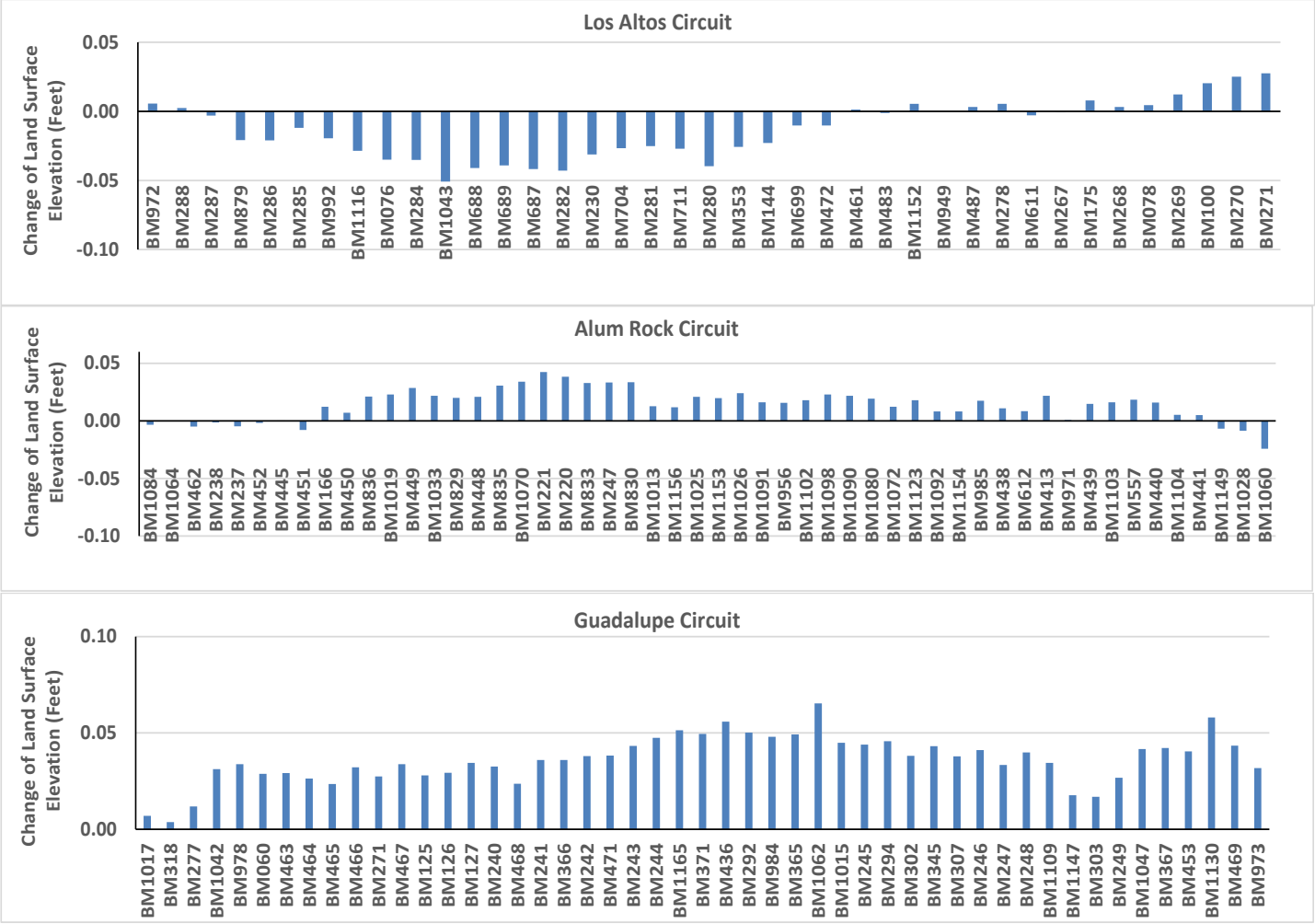


Figure 8. **Average annual change of land surface elevations from 2008 to 2018 along the three benchmark circuits (shown from west to east for Los Altos and Alum Rock, and north to south for Guadalupe)**

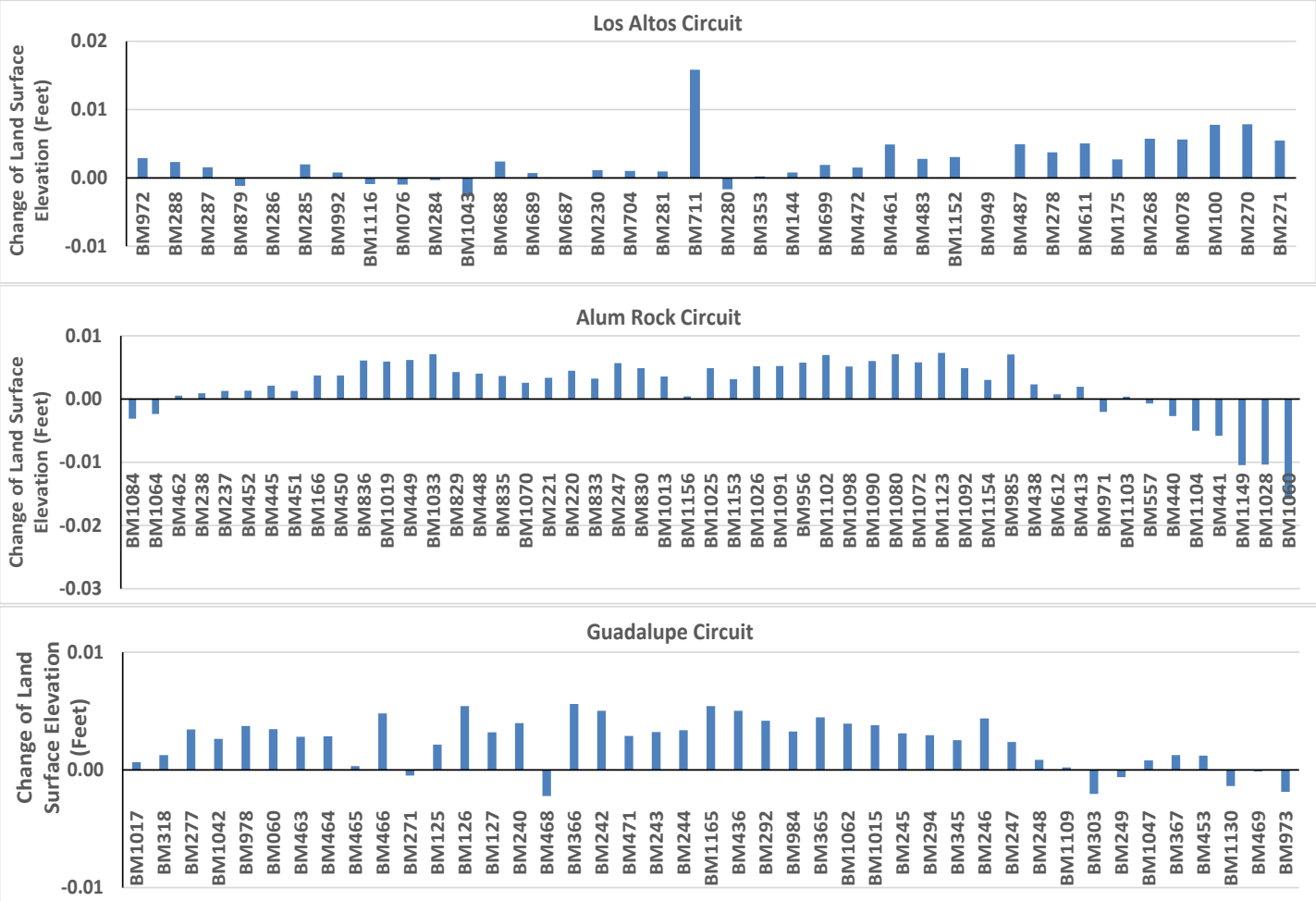
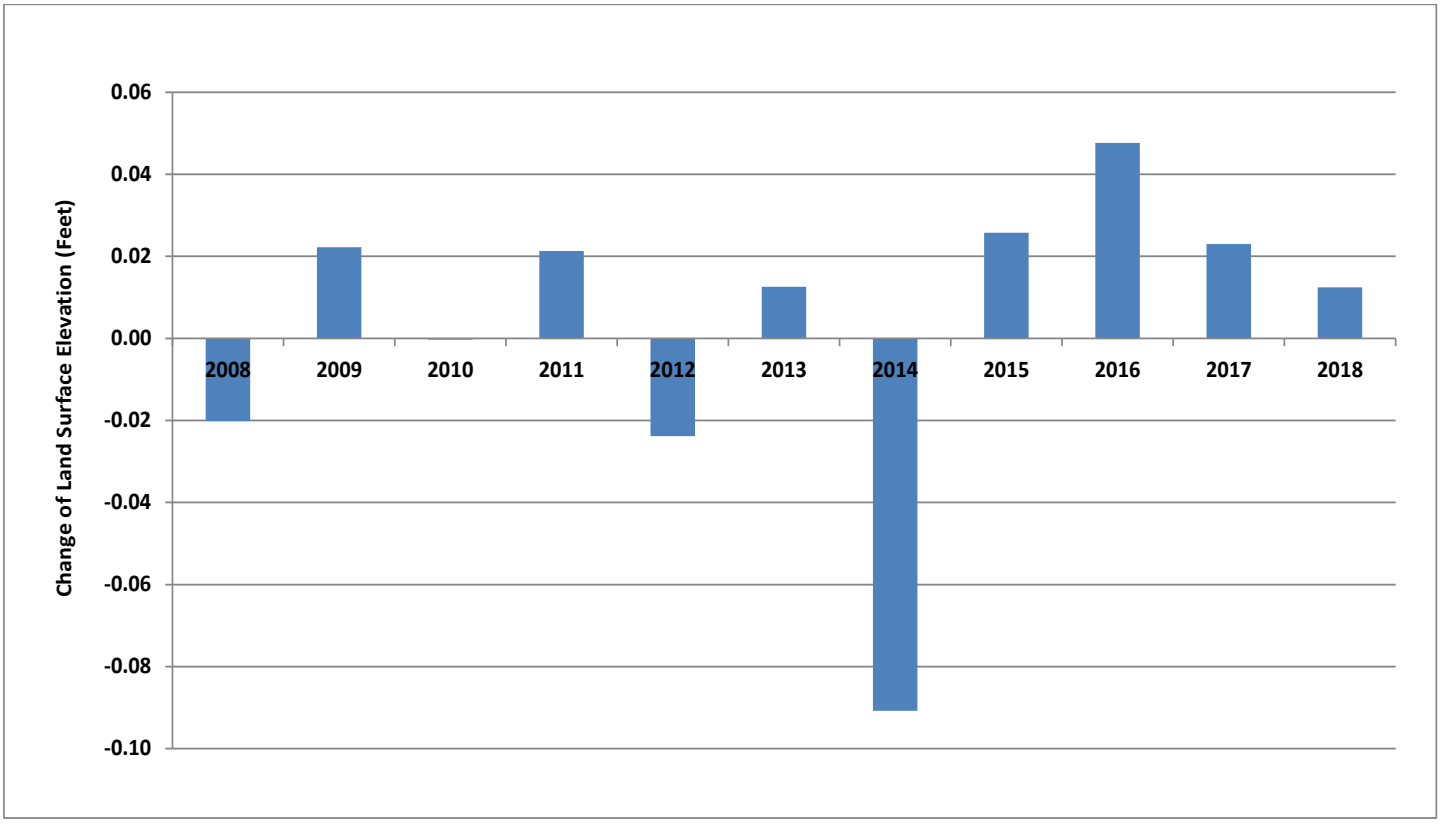


Figure 9. Average annual change of land surface elevation along the three benchmark circuits from 2008 to 2018



Appendix B

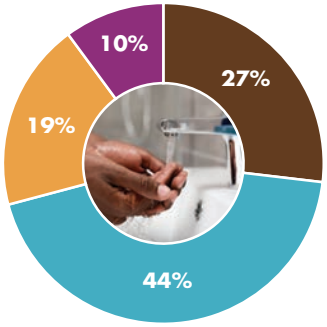
2018 Groundwater Quality Summary Provided to Well Owners

Valley Water

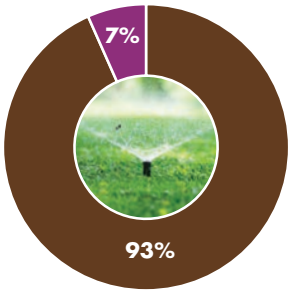
Annual Groundwater Quality Summary Report

For Testing Performed in 2018

NORTH COUNTY WATER USE



SOUTH COUNTY WATER USE



- Groundwater
- Treated Water
- Hetch-Hetchy
- Other Local and Recycled Water

Protecting our Groundwater

Groundwater is an essential local water resource, providing about half of the water used in Santa Clara County each year. In some areas, groundwater is the only source of drinking water. Protecting our groundwater helps ensure that adequate supplies are available now and in the future.

Valley Water works to safeguard groundwater by:

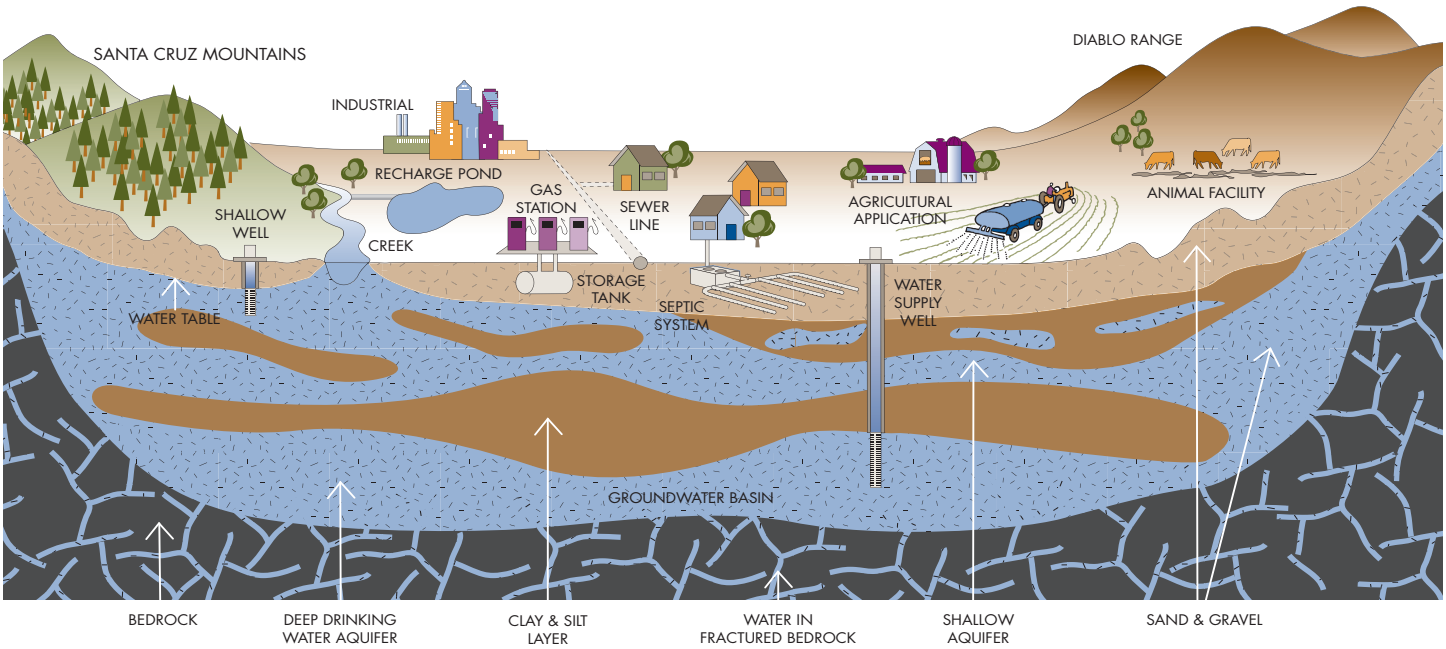
- Replenishing groundwater with local and imported surface water.
- Reducing demands on groundwater through the delivery of treated water, water conservation, and water recycling.
- Monitoring groundwater and conducting programs to protect against contamination.

Well water testing throughout the county indicates that groundwater quality is generally very good. All drinking water, whether treated municipal, groundwater, or bottled, contains small amounts of some contaminants. As water travels over the surface of the land and through the ground, it absorbs naturally occurring minerals and can pick up substances from animal and human activities.

Contaminants that may be present in groundwater include:

- Microbial contaminants such as viruses and bacteria that may come from sewage treatment plants, sewer lines, septic systems, agricultural operations, and wildlife.
- Inorganic contaminants such as salts and metals that can be naturally occurring or result from industrial or domestic wastewater discharges, animal facilities, farming, and mining.
- Insecticides, herbicides, and fertilizers that may come from agriculture and residential uses.
- Organic chemicals including synthetic and volatile chemicals from industrial processes, gas stations, dry cleaners, agricultural application, and septic systems.
- Radioactive contaminants that are naturally occurring in our area.

The presence of natural or man-made contaminants does not necessarily indicate that water poses a health risk. State and federal drinking water standards identify maximum contaminant levels that relate to health risk.



2018 Groundwater Quality Summary

Monitoring confirms generally high groundwater quality, but South County nitrate is a concern

In 2018, Valley Water sampled over 225 domestic wells and evaluated data from over 240 public water supply wells in North and South County (see map on back page). Nearly all wells tested meet drinking water standards except for nitrate in some South County domestic wells. Valley Water works with regulatory and land use agencies on this ongoing challenge.

The table below summarizes the results for any substance that was detected in 2018; not every well was tested for all substances listed. Although Maximum Contaminant Levels (MCLs) apply only to public water systems, MCLs are helpful in understanding results from domestic wells. Please note this regional summary may not reflect the water quality in your well since every property and well is unique.

Primary Drinking Water Standards – Public Health Related Standards	Units	Maximum Contaminant Level	Public Health Goal	North County		South County		
Inorganic Contaminants				**Median**	**Range**	**Median**	**Range**	**Typical Sources**
Aluminum	ppb	1,000	600	14	ND - 73	17	ND - 40	Erosion of natural deposits
Arsenic	ppb	10	0.004	ND	ND - 4	ND	ND - 5	Erosion of natural deposits; glass and electronics production waste
Asbestos	MFL	7	7	ND	ND	0.7	ND - 1.2	Erosion of natural deposits
Barium	ppb	1,000	2,000	120	ND - 270	100	ND - 300	Erosion of natural deposits
Chromium (total)	ppb	50	--	ND	ND - 1.9	1.40	ND - 7.61	Erosion of natural deposits; metal plating
Copper[1]	ppb	1,300	300	2.4	1.9 - 11	1.8	ND - 8.9	Internal corrosion of household plumbing systems; erosion of natural deposits
Fluoride (Natural Source)	ppm	2	1	0.10	ND - 0.34	0.10	ND - 0.74	Erosion of natural deposits
Lead[1]	ppb	15	0.2	ND	ND - 1.4	ND	ND	Erosion of natural deposits; internal corrosion of household water plumbing systems; industrial discharges
Nickel	ppb	100	12	ND	ND - 1	ND	ND - 5.1	Erosion of natural deposits; discharge from metal industries
Nitrate + Nitrite (as N)	ppm	10	10	3.7	0.5 - 7.7	4.2	ND - 43	Runoff and leaching from fertilizer use; leaching from septic tanks and sewage; erosion of natural deposits
Nitrate (as N)	ppm	10	10	3	ND - 12	3.9	ND - 48	Runoff and leaching from fertilizer use; leaching from septic tanks and sewage; erosion of natural deposits
Perchlorate	ppb	6	1	ND	ND	ND	ND - 5.6	Solid rocket propellant, fireworks, explosives, flares, matches, and other industrial sources
Selenium	ppb	50	30	ND	ND - 5.0	ND	ND - 5.8	Erosion of natural deposits
Radioactive Contaminants								
Gross Alpha	pCi/L	15	--	ND	ND - 3	3	3	Erosion of natural deposits
Radium 228[2]	pCi/L	--	0.019	ND	ND - 0.346	--	--	Erosion of natural deposits
Uranium	pCi/L	20	0.43	ND	ND - 1.1	--	--	Erosion of natural deposits
Volatile Organic Chemicals								
1,1,1-Trichloroethane (1,1,1-TCA)	ppb	200	1,000	ND	ND - 1.1	ND	ND	Discharge from metal degreasing and other industrial processes
1,1-Dichloroethene (1,1-DCE)	ppb	6	10	ND	ND - 0.64	ND	ND	Discharge from industrial processes
1,2,3-Trichloropropane (TCP)	ppb	0.005	0.0007	ND	ND - 0.0116[3]	ND	ND	Discharge from industrial processes
Tetrachloroethene (PCE)	ppb	5	0.06	ND	ND	ND	ND - 2.7	Discharge from industrial processes, dry cleaners, and automotive repair
Toluene	ppb	150	150	ND	ND	ND	ND - 20	Discharge from industrial processes and leaking underground gas tanks
Total Trihalomethanes (THMs)	ppb	80	--	ND	ND - 4.4	7.6	7.6	Drinking water chlorination
Microbiological Contaminants[4]				**Present**	**Absent**	**Present**	**Absent**	**Typical Sources**
E. Coli Bacteria		--	--	2	19	2	227	Human and animal fecal waste
Total Coliform Bacteria		--	--	11	10	69	160	Naturally present in the environment

Notes:
1) Lead and copper do not have primary MCLs but have "action levels" of 15 and 1,300 ppb, respectively. These substances are regulated by the state for public water systems since they can adversely affect public health.
2) The MCL for combined Radium 226 + 228 is 5 pCi/L.
3) Verification sampling did not confirm the high TCP result. All subsequent results were below the detection level (0.005 ppb).
4) The table shows the number of domestic wells tested that had bacteria present or absent. Public water systems are required to ensure that fewer than 5% of samples per month have total coliform present and that no samples have e.coli present. Domestic wells are not subject to these standards.
5) -- indicates there is no related drinking water standard or that the substance was not tested or detected.

Terms and Definitions

Color units: A measure of color in water

Maximum Contaminant Level (MCL): the highest level of a contaminant allowed in public water systems. Primary MCLs are set as close to PHGs as is economically and technologically feasible. Secondary MCLs protect the odor, taste, and appearance of drinking water.

Median: the "middle" value of the results, with half of the values above the median and half of the values below the median.

Public Health Goal (PHG): the level of a contaminant in drinking water below which there is no known or expected risk to human health. PHGs are set by the California EPA.

ND: Not detected (at laboratory testing limit)

NTU: Nephelometric Turbidity Units

pCi/L: picoCuries per liter (a measure of radiation)

pH units: measure of pH

ppm: parts per million (milligrams per liter)

ppb: parts per billion (micrograms per liter)

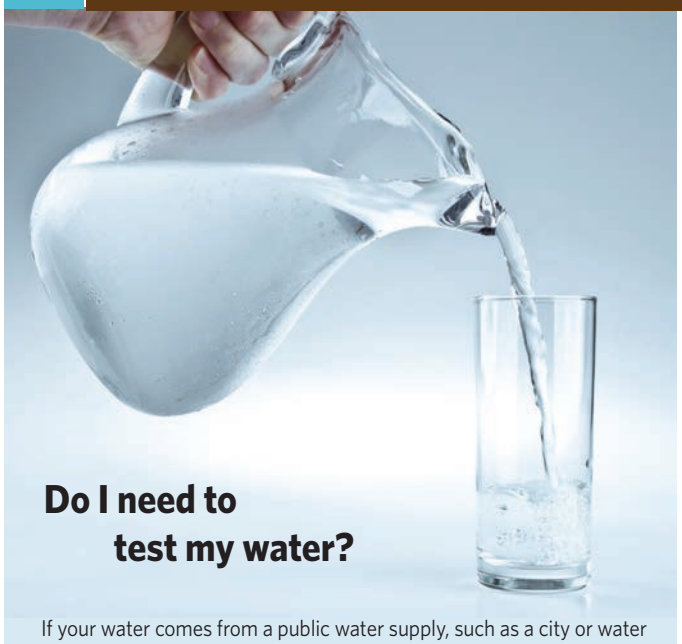
ppt: parts per trillion (nanograms per liter)

TON: Threshold Odor Number

uS/cm: microSiemens per centimeter (a measure of the dissolved inorganic salt content)

2018 Groundwater Quality Summary

Secondary Drinking Water Standards – Aesthetic Standards	Units	Maximum Contaminant Level	Public Health Goal	North County		South County		Typical Sources
				Median	Range	Median	Range	
Chloride	ppm	250	--	52	19 - 86	43	8 - 140	Runoff/leaching from natural deposits; seawater influence
Color	Color units	15	--	ND	ND - 7	ND	ND	Naturally-occurring organic materials
Iron	ppb	300	--	ND	ND - 3,100	1	ND - 8,600	Leaching from natural deposits; industrial discharges
Manganese	ppb	50	--	ND	ND - 111	0.4	ND - 150	Leaching from natural deposits; industrial discharges
Odor Threshold	TON	3	--	ND	ND - 2	ND	ND - 1	Naturally-occurring organic materials
pH	pH units	6.5 - 8.5	--	7.6	6.9 - 8.1	7.6	7.0 - 7.9	Erosion of natural deposits; carbon dioxide emissions; rainfall
Specific Conductance	uS/cm	900	--	695	470 - 1,000	634	366 - 1,360	Substances that form ions when in water; seawater influence
Sulfate	ppm	250	--	42	6 - 121	35	ND - 374	Runoff/leaching from natural deposits; industrial discharges
Total Dissolved Solids (TDS)	ppm	500	--	405	256 - 864	398	210 - 1,680	Runoff/leaching from natural deposits
Turbidity	NTU	5	--	0.2	ND - 2.0	0.15	ND - 0.78	Soil runoff
Zinc	ppb	5,000	--	ND	ND	1	ND - 560	Runoff/leaching from natural deposits; industrial discharges
Other Water Quality Parameters								
Alkalinity (total, as CaCO3)	ppm	--	--	220	130 - 380	190	98 - 370	Atmospheric and vadose zone carbon dioxide
Boron	ppb	--	--	ND	ND - 184	120	ND - 2,400	Erosion of natural deposits
Bromide	ppm	--	--	0.15	0.10 - 0.64	0.17	ND - 1.54	Erosion of natural deposits; seawater intrusion; sea spray
Bromodichloromethane (THM)	ppb	--	--	ND	ND - 0.72	ND	ND	Drinking water chlorination
Bromoform (THM)	ppb	--	--	ND	ND - 1.83	ND	ND	Drinking water chlorination
Calcium	ppm	--	--	72	26 - 110	52	29 - 98.9	Erosion of natural deposits
Carbon Dioxide	ppb	--	--	7.0	3.1 - 30	--	--	Atmospheric sources; dissolution of carbonate rocks
Carbonate (as CO3)	ppm	--	--	ND	ND - 2.1	ND	ND	Atmospheric sources; dissolution of carbonate rocks
Chloroform (THM)	ppb	--	--	ND	ND	ND	ND - 7.6	Drinking water chlorination
Chromium 6 (hexavalent)	ppb	--	0.02	1.12	ND - 3.70	1.19	ND - 2.62	Erosion of natural deposits; metal plating and industrial discharges
Cobalt	ppb	--	--	ND	ND - 0.153	ND	ND	Leaching from natural deposits; industrial discharges
DCPA (Total Di & Mono Acid Degradates)	ppb	--	--	ND	ND - 0.13	--	--	Herbicide used to control grasses and weeds
Dibromochloromethane (THM)	ppb	--	--	ND	ND - 1.62	ND	ND	Drinking water chlorination
Hardness (total, as CaCO3)	ppm	--	--	298	100 - 558	261	ND - 931	Erosion of natural deposits
Lithium	ppb	--	--	3	ND - 8.1	9	ND - 27	Erosion of natural deposits; industrial discharges
Magnesium	ppm	--	--	26	8.9 - 58	30	9.2 - 68	Erosion of natural deposits
Molybdenum	ppb	--	--	ND	ND - 2.2	ND	ND - 4.4	Erosion of natural deposits
Orthophosphate	ppm	--	--	0.11	ND - 0.30	0.06	ND - 1.12	Leaching from natural deposits; agricultural runoff
Perfluorohexane Sulfonic Acid (PFHXS)	ppt	--	--	1.95	ND - 3	--	--	Discharge from industrial processes
Perfluorohexanoic Acid (PFHXA)	ppt	--	--	1.75	ND - 2.5	--	--	Discharge from industrial processes
Potassium	ppm	--	--	1.2	ND - 1.7	1.2	ND - 1.8	Erosion of natural deposits
Silica	ppm	--	--	28.8	28.2 - 30.6	28.9	22.1 - 48.4	Erosion of natural deposits
Sodium	ppm	--	--	30	16.5 - 69	25.2	12.3 - 74.2	Erosion of natural deposits
Total Organic Carbon (TOC)	ppm	--	--	ND	ND - 1.6	--	--	Various natural and manmade sources
Vanadium	ppb	--	--	ND	ND - 10.6	1.8	ND - 14	Erosion of natural deposits; discharge from industrial processes



Do I need to test my water?

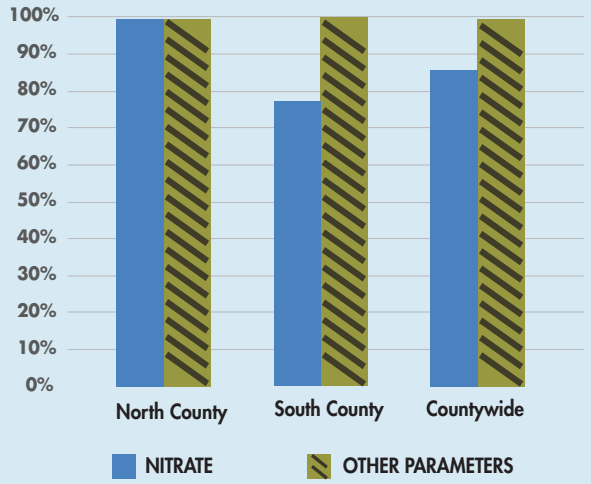
If your water comes from a public water supply, such as a city or water company, it is tested regularly to make sure it meets state and federal drinking water standards.

If your water comes from a private well, the well owner is responsible for making sure it is safe to drink. Although Valley Water monitors regional groundwater quality, every property and well is unique. Some contaminants are colorless and odorless, so the first step in protecting your health is having your water tested.

Valley Water encourages private well owners to have their well water tested by a state-certified laboratory annually or anytime there is a change in taste, odor, or appearance. If your water contains any contaminant above drinking water standards, you may want to install a treatment system or use an alternative source of water.

Valley Water currently offers eligible domestic well users free basic water quality testing and rebates of up to $500 for nitrate treatment systems. Call the Groundwater Hotline at (408) 630-2300 for more information.

WATER SUPPLY WELLS TESTED IN 2018 MEETING PRIMARY DRINKING WATER STANDARDS



Everyone has a role in protecting groundwater. Well owners should maintain their wells and septic systems and create a zone of protection around their wells where no potential contaminants are used or stored. ***See Valley Water's Guide for the Private Well Owner at www.valleywater.org for helpful tips.*** All residents can help by conserving water and by raising awareness that activities on the land surface can affect our largest drinking water reservoir, which is beneath our feet.

Water Quality Challenges

Nitrate

As shown in the chart to the left, nitrate is an ongoing challenge, particularly in South County. Common sources are fertilizers, septic systems and livestock waste, so nitrate is often higher in rural and agricultural areas. Nitrate can interfere with the blood's ability to transport oxygen and is of greatest concern for infants and pregnant women. The effects of consuming high levels of nitrate are often referred to as "blue baby syndrome" and symptoms include shortness of breath and blueness of the skin.

Valley Water monitors nitrate conditions and trends, helps dilute nitrate through groundwater replenishment, and works with land use and regulatory agencies to address elevated nitrate in groundwater. To help reduce well owner exposure to elevated nitrate, Valley Water is offering rebates of up to $500 for eligible treatment systems. Call the Groundwater Hotline at (408) 630-2300 for more information.

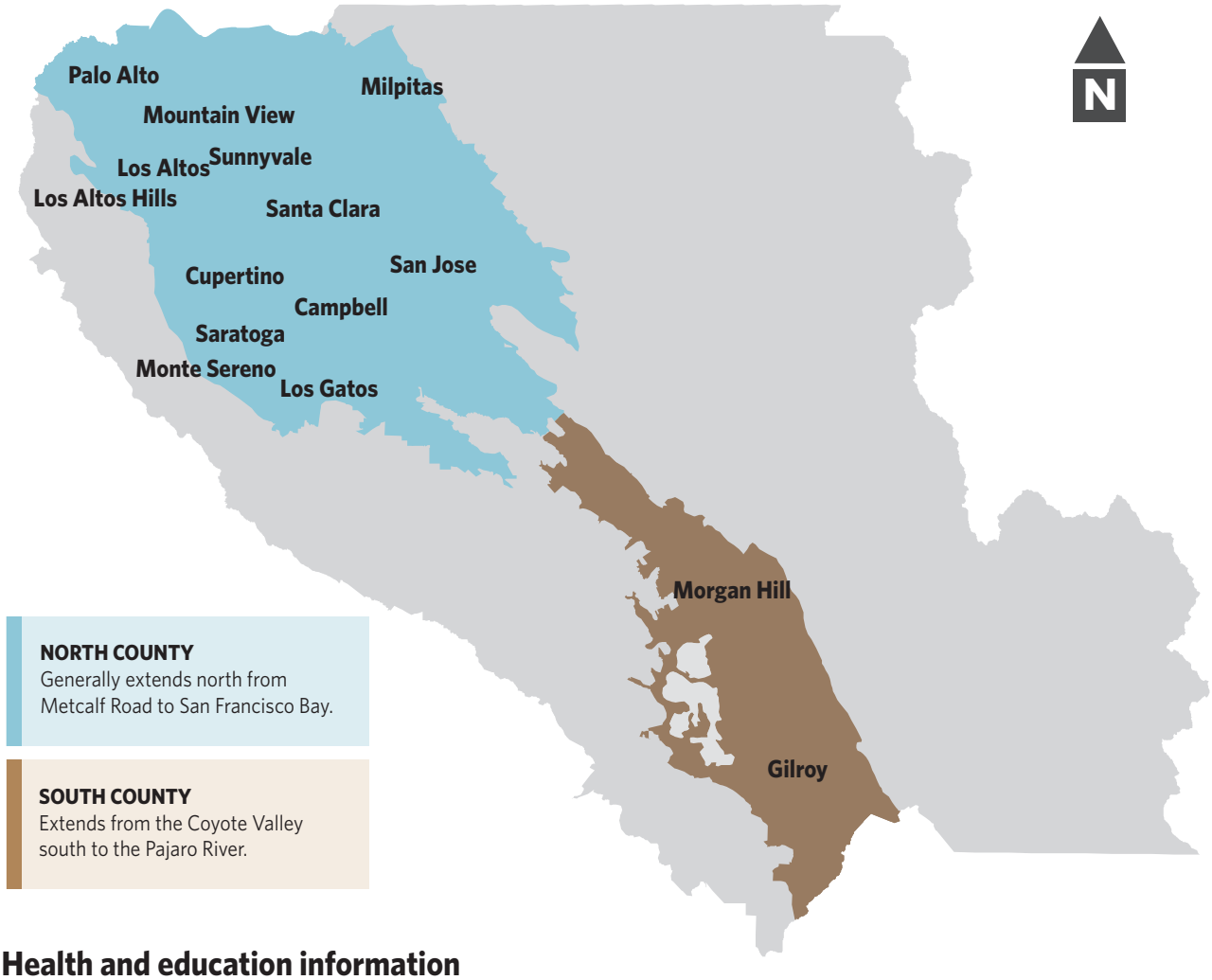
1,2,3-Trichloropropane

1,2,3-trichloropropane, also known as 1,2,3-TCP, is a volatile organic compound that has been used as a cleaning and degreasing solvent and is also associated with pesticide products. The detection of elevated 1,2,3-TCP located in two North County wells does not indicate a widespread concern. Subsequent testing did not show 1,2,3-TCP present in those wells.

Perchlorate

Perchlorate is a salt used in rocket fuel, highway flares, fireworks and other products. At high levels, perchlorate can interfere with the thyroid gland and affect hormones that regulate metabolism and growth. Perchlorate contamination from a former highway flare manufacturer in Morgan Hill was first discovered in 2000. Due to cleanup activities and groundwater recharge, perchlorate levels have decreased dramatically. The area affected is getting smaller, now extending from Tennant Avenue south to approximately San Martin Avenue. The responsible party continues to remediate and monitor contaminated groundwater and provides treatment systems or alternative water supplies for impacted water supply wells (currently seven). Valley Water continues to work with the Central Coast Regional Water Quality Board and others involved to ensure groundwater quality is restored as soon as possible.

You live on a groundwater basin.



NORTH COUNTY
Generally extends north from Metcalf Road to San Francisco Bay.

SOUTH COUNTY
Extends from the Coyote Valley south to the Pajaro River.

Health and education information

All drinking water, including bottled water, may reasonably be expected to contain small amounts of some contaminants. The presence of contaminants does not necessarily indicate that the water poses a health risk. More information about contaminants and potential health effects can be obtained from the U.S. Environmental Protection Agency's Safe Drinking Water Hotline **(800-426-4791)**, the California Division of Drinking Water ***(www.waterboards.ca.gov/drinking_water/programs)***, the California Office of Environmental Health Hazard Assessment ***(www.oehha.ca.gov/water)***, or from your healthcare provider.

CONTACT US

For more information regarding groundwater quality, contact **Victoria Garcia** at **(408) 630-3136** or by email at ***VGarcia@valleywater.org.*** Or use our **Access Valley Water** customer request and information system at ***https://delivr.com/2yukx*** to find out the latest information on Valley Water projects or to submit questions, complaints or compliments directly to a Valley Water staff person.

FOLLOW US

scvwd
valleywater
valleywater
Join our mailing list: ***https://delivr.com/2uz9z***

© 2019 Santa Clara Valley Water District • 6/2019 JL

Appendix C

2018 Groundwater Quality Results

Table C-1 Summary of 2018 Water Quality Indicator Data

Parameter	Units[1]	Santa Clara Subbasin, Santa Clara Plain								Santa Clara Subbasin, Coyote Valley				Maximum Contaminant Level	
		Shallow Zone[2]				Principal Zone[3]									
		n[4]	Min[5]	Median[6]	Max	n	Min	Median	Max	n	Min	Median	Max	MCL[7]	SMCL[8]
Aggressive Index (Corrosivity)	Index	--	--	--	--	47	11.48	12	13	2	11.87	11.95	12.02	--	--
Total Alkalinity (as CaCO3)	mg/L	12	178	263	593	72	130	220	380	8	150	211	301	--	--
Bicarbonate Alkalinity (as CaCO3)	mg/L	10	217	346	723	17	166	287	436	3	245	258	352	--	--
Carbonate Alkalinity (as CaCO3)	mg/L	--	--	--	--	16	<2	<2	2.1	--	--	--	--	--	--
Hydroxide Alkalinity (as CaCO3)	mg/L	--	--	--	--	16	<2	<2	<5	--	--	--	--	--	--
Caffeine	ug/L	--	--	--	--	20	<0.05	<0.05	<0.05	--	--	--	--	--	--
Color	Color Units	--	--	--	--	18	<3	<3	7	--	--	--	--	--	15
E. Coli (MPN)	MPN/100mL	--	--	--	--	--	--	--	--	--	--	--	--	--	--
E. Coli (P/A)	P/A	4	2 Absent	2 Present		4	3 Absent	1 Present		20	20 Absent	0 Present		--	--
Foaming Agents (MBAS)	ug/L	--	--	--	--	13	<0.1	<0.1	<0.1	--	--	--	--	--	500
Hardness (Total, as CaCO3)	mg/L	21	186	351	668	80	56	295	558	26	140	261	468	--	--
Langelier Index @ 60 C	Index	--	--	--	--	27	0.044	0.74	1.3	--	--	--	--	--	--
Langelier Index @ Source Temp	Index	--	--	--	--	19	-0.59	-0.09	0.52	--	--	--	--	--	--
Odor Threshold @ 60 C	TON	--	--	--	--	60	<1	<1	2	2	<1	<1	<1	--	3
Oxidation Reduction Potential (ORP)	mV	--	--	--	--	--	--	--	--	--	--	--	--	--	--
pH, Field	pH Units	--	--	--	--	16	7.1	7.5	8	--	--	--	--	--	6.5 - 8.5
pH, Laboratory	pH Units	--	--	--	--	59	6.9	7.6	8.1	2	7.6	7.6	7.6	--	6.5 - 8.5
Source Temperature	C	--	--	--	--	16	17	19	24	--	--	--	--	--	--
Specific Conductance	uS/cm	17	536	788	1,350	72	393	695	1,000	10	561	617	971	--	900
Total Coliform (P/A)	P/A	4	0 Absent	4 Present		4	2 Absent	2 Present		20	10 Absent	10 Present		--	--
Total Organic Carbon (TOC)	mg/L	--	--	--	--	7	<0.3	<0.3	1.6	--	--	--	--	--	--
Turbidity, Laboratory	NTU	19	<0.1	0.1	5.2	78	<0.1	0.2	21	8	<0.1	0.2	0.27	--	5
Turbidity, Field	NTU	--	--	--	--	--	--	--	--	--	--	--	--	--	5

Table C-1 Summary of 2018 Water Quality Indicator Data

Parameter	Units[1]	Llagas Subbasin								Maximum Contaminant Level	
		Shallow Zone				Principal Zone					
		n	Min	Median	Max	n	Min	Median	Max	MCL[7]	SMCL[8]
Aggressive Index (Corrosivity)	Index	--	--	--	--	15	11.6	12.0	12.3	--	--
Total Alkalinity (as CaCO3)	mg/L	17	106	196	347	34	98	191	370	--	--
Bicarbonate Alkalinity (as CaCO3)	mg/L	12	130	228	423	2	186	220	253	--	--
Carbonate Alkalinity (as CaCO3)	mg/L	--	--	--	--	1	<10	<10	<10	--	--
Hydroxide Alkalinity (as CaCO3)	mg/L	--	--	--	--	1	<10	<10	<10	--	--
Color	Color Units	--	--	--	--	1	<3	<3	<3	--	15
Dissolved Oxygen	mg/L	2	1.50	1.72	1.94	--	--	--	--	--	--
E. Coli (MPN)	MPN/100mL	1	<1	<1	<1	--	--	--	--	--	--
E. Coli (P/A)	P/A	16	16 Absent	0 Present		78	77 Absent	1 Present		--	--
Foaming Agents (MBAS)	ug/L	2	<0.1	<0.1	<0.1	1	<0.05	<0.05	<0.05	--	500
Hardness (Total, as CaCO3)	mg/L	29	141	287	592	99	<10	257	632	--	--
Heterotrophic Plate Count	CFU/mL	1	110	110	110	--	--	--	--	--	--
Langelier Index @ 60 C	Index	--	--	--	--	6	-0.06	0.12	0.41	--	--
Langelier Index @ Source Temp	Index	--	--	--	--	1	-0.78	-0.78	-0.78	--	--
Odor Threshold @ 60 C	TON	--	--	--	--	16	<1	<1	1	--	3
Oxidation Reduction Potential (ORP)	mV	2	125	150	174	--	--	--	--	--	--
pH, Field	pH Units	2	6.9	7.1	7.4	--	--	--	--	--	6.5 - 8.5
pH, Laboratory	pH Units	--	--	--	--	17	7.00	7.60	7.89	--	6.5 - 8.5
Source Temperature	C	2	18.4	19.3	20.1	--	--	--	--	--	--
Specific Conductance	uS/cm	21	366	680	1,240	91	408	625	1,360	--	900
Total Coliform (MPN)	MPN/100mL	1	<1	<1	<1	--	--	--	--	--	--
Total Coliform (P/A)	P/A	16	12 Absent	4 Present		78	51 Absent	27 Present		--	--
Turbidity, Laboratory	NTU	15	<0.1	0.2	1.4	33	<0.1	0.2	0.78	--	5
Turbidity, Field	NTU	2	0.51	0.52	0.53	--	--	--	--	--	5

Table C-1 Summary of 2018 Water Quality Indicator Data (Notes)

Table includes data for wells monitored by the District (monitoring wells and water supply wells) and public water system data reported to the CA Division of Drinking Water (DDW)

Only wells with known construction information are presented in this table. DDW wells are assumed to represent the principal zone if no construction information is available, as these are typically deep wells.

1 ug/L = micrograms per liter; mg/L = milligrams per liter; P/A = present/absent per 100 ml; uS/cm = microSiemens per centimeter; NTU = Nephelometric Turbidity Units; TON = Threshold Odor Number
2 The shallow aquifer zone is represented by wells primarily drawing water from depths less than 150 feet.
3 The principal aquifer zone is represented by wells primarily drawing water from depths greater than 150 feet.
4 n = number of results for each parameter. Some parameters may have been analyzed more than once at a particular well.
5 The minimum shown is the lowest detected value. The lowest reporting limit (e.g., <5) is shown when there are no quantified values at the lowest reporting limit.
6 For parameters with results reported at multiple reporting limits, the median was computed using the Maximum Likelihood Estimate (MLE) method.
7 MCL = Maximum Contaminant Level specified in Title 22 of the California Code of Regulations. The MCL is a health-based drinking water standard.
8 SMCL = Secondary Maximum Contaminant Level, or aesthetic-based standard, per DDW or US EPA. For SMCLs having a range, the lower, recommended threshold is listed first with the upper threshold in parentheses.
9 Total coliform and e. coli bacteria are regulated under the US EPA Total Coliform Rule, which identifies sampling requirements and compliance criteria based on the type of public water system. All wells with data in bacteria results in this table are private, domestic wells that are not subject to federal or state drinking water requirements.

Table C-2 Summary of 2018 Inorganic Data

Parameter	Units[1]	Santa Clara Subbasin, Santa Clara Plain								Santa Clara Subbasin, Coyote Valley				Maximum Contaminant Level	
		Shallow Zone[2]				Principal Zone[3]									
		n[4]	Min[5]	Median[6]	Max	n	Min	Median	Max	n	Min	Median	Max	MCL[7]	SMCL[8]
Major and Minor Ions															
Bicarbonate (as HCO3)	mg/L	2	300	310	320	55	150	270	470	5	180	260	367	--	--
Bromide	mg/L	14	0.07	0.17	0.3	29	<0.05	0.15	1.49	24	<0.05	0.13	1.54	--	--
Calcium	mg/L	19	38.6	63.4	154	76	11.8	69.2	111	8	6.7	51	98.9	--	--
Calcium (as CaCO3)	mg/L	19	96.5	158	385	19	29.6	146	279	6	16.8	133	247	--	--
Carbon Dioxide	ug/L	--	--	--	--	29	3.1	7	30	--	--	--	--	--	--
Chloride	mg/L	19	27	59	85	72	11	49	86	8	15	42	86	--	250
Cyanide	ug/L	--	--	--	--	31	<100	<100	<100	3	<100	<100	<100	150	--
Fluoride (natural source)	mg/L	14	<0.1	0.1	0.31	76	<0.1	0.1	0.22	27	<0.05	0.12	0.15	2	--
Magnesium	mg/L	19	12.2	36.7	69.6	76	5	25	58	8	22	32	56.8	--	--
Perchlorate	ug/L	12	<4	<4	<4	56	<4	<4	<4	9	<4	<4	<4	6	--
Potassium	mg/L	19	0.7	1	2.4	59	<1	1.3	2.9	8	0.9	1	2.0	--	--
Silica	mg/L	19	19	24	36	25	19	28	42	6	21	23	36	--	--
Sodium	mg/L	19	22	40	206	76	16	30	95.3	8	24	25	114	--	--
Sodium Adsorption Ratio	ratio	2	1.11	1.30	1.48	52	0.55	0.96	2.61	5	0.73	0.83	3.60	--	--
Sulfate	mg/L	14	26	55	163	76	1.9	42	121	26	<0.5	45	93	--	250
Total Dissolved Solids (TDS)	mg/L	21	300	460	980	76	230	400	832	31	300	394	1,480	--	500
Nutrients															
Ammonia (NH3-N)	mg/L	--	--	--	--	6	<0.05	<0.05	<0.05	--	--	--	--	--	--
Nitrate + Nitrite (as N)	ug/L	--	--	--	--	45	0.49	3.7	7.7	6	0.49	1.2	6.9	10	--
Nitrate (as N)	mg/L	15	<0.05	1.6	3.2	276	<0.05	3.3	9.2	46	<0.05	3.8	18.9	10	--
Nitrite (as N)	ug/L	--	--	--	--	55	<0.4	<0.4	<0.4	6	<0.4	<0.4	<0.4	1,000	--
Orthophosphate (Dissolved, as P)	mg/L	14	0.07	0.15	0.47	29	<0.05	0.18	1.78	24	<0.05	0.07	0.48	--	--
Trace Elements															
Aluminum	ug/L	19	<20	24	63	79	<20	14	1,700	10	<20	23.5	40	1,000	200
Antimony	ug/L	19	<1	<1	<1	76	<1	<6	<6	9	<1	<1	<6	6	--
Arsenic	ug/L	19	<2	<2	11	76	<2	<2	5.0	9	<2	<2	<2	10	--
Asbestos	MFL	--	--	--	--	7	<0.2	<0.2	<0.2	--	--	--	--	7	--
Barium	ug/L	19	31	110	330	74	<100	110	270	9	<100	110	240	1,000	--
Beryllium	ug/L	19	<1	<1	<1	75	<1	<1	<1	9	<1	<1	<1	4	--
Boron	ug/L	19	93	184	853	29	<100	127	322	6	50	121	156	--	--
Cadmium	ug/L	19	<1	<1	<1	75	<1	<1	<1	9	<1	<1	<1	5	--
Chromium	ug/L	19	<1	<1	3.2	79	<1	<1	10	9	<1	1.9	7.61	50	--
Chromium 6 (Hexavalent)	ug/L	19	<1	<1	3.3	35	<1	<1	9.93	6	<1	1.42	3.97	--	--
Cobalt	ug/L	19	<1	<1	<1	28	0.13	0.14	0.15	6	<1	<1	<1	--	--
Copper[9]	ug/L	19	<1	1	11	76	<1	<1	3.0	8	<1	0.8	2.8	1,300	1,000
Iron	ug/L	19	<20	<20	170	120	<20	22	3,600	11	<20	<20	8,600	--	300
Lead[9]	ug/L	19	<1	<1	1.4	75	<1	<1	2.6	8	<1	<1	<5	15	--
Lithium	ug/L	19	<5	7	20	25	<5	6.0	29	6	8	10	25	--	--
Manganese	ug/L	19	<1	30	1,020	87	<1	0.79	141	8	<1	<1	119	--	50
Mercury	ug/L	19	<1	<1	<1	72	<1	<1	<1	9	<1	<1	<1	2	--
Molybdenum	ug/L	19	<1	1.9	25	28	<1	<1	11	6	<1	<1	12	--	--
Nickel	ug/L	19	<1	<1	2.5	74	<1	<1	4.6	9	<1	<1	1.3	100	--
Selenium	ug/L	19	<5	<5	<5	75	<2	<5	5	9	<5	<5	<5	50	--
Silver	ug/L	19	<1	<1	<1	72	<1	<10	<10	8	<1	<1	<10	--	100
Thallium	ug/L	19	<1	<1	<1	75	<1	<1	<1	9	<1	<1	<1	2	--
Vanadium	ug/L	19	<1	2	4.4	28	<1	2	10.5	6	<1	2	10	--	--
Zinc	ug/L	19	<10	<10	37	76	<10	<50	760	8	<10	<10	560	--	5,000

Table C-2 Summary of 2018 Inorganic Data

Parameter	Units[1]	Llagas Subbasin								Maximum Contaminant Level	
		Shallow Zone				Principal Zone					
		n	Min	Median	Max	n	Min	Median	Max	MCL[7]	SMCL[8]
Major and Minor Ions											
Bicarbonate (as HCO3)	mg/L	4	204	341	414	32	119	233	450	--	--
Bromate	ug/L	2	<0.25	<0.25	<0.25	--	--	--	--	10	--
Bromide	mg/L	29	<0.05	0.1	0.33	83	<0.05	0.17	0.56	--	--
Calcium	mg/L	17	31	61	105	35	29	54	94	--	--
Calcium (as CaCO3)	mg/L	17	76.4	153	264	17	72.8	146	234	--	--
Chloride	mg/L	17	16	48	78	34	8.0	38	140	--	250
Cyanide	ug/L	1	<0.005	<0.005	<0.005	20	<3	<100	<100	150	--
Fluoride (natural source)	mg/L	29	<0.05	0.06	0.22	104	<0.05	0.09	0.33	2	--
Magnesium	mg/L	17	15.9	38	80	34	9.0	30	68	--	--
Perchlorate	ug/L	16	<4	<4	4.38	84	<4	<4	5.6	6	--
Potassium	mg/L	17	<0.5	1	1.7	25	<0.5	1	2	--	--
Silica	mg/L	17	21	29	41	17	23	30	48	--	--
Sodium	mg/L	17	13	27	77	34	12	26	74	--	--
Sodium Adsorption Ratio	ratio	4	0.39	0.8	1.2	31	0.40	0.7	2.6	--	--
Sulfate	mg/L	29	10	34	126	99	5	34	113	--	250
Total Dissolved Solids (TDS)	mg/L	27	78	378	730	93	248	387	774	--	500
Nutrients											
Nitrate + Nitrite (as N)	ug/L	--	--	--	--	23	<0.4	5	43	10	--
Nitrate (as N)	mg/L	29	<0.05	9	56	234	<0.4	6	43	10	--
Nitrite (as N)	ug/L	--	--	--	--	23	<0.1	<0.4	<0.4	1,000	--
Orthophosphate (Dissolved, as P)	mg/L	29	<0.05	0.07	0.67	83	<0.1	0.1	1.1	--	--
Trace Elements											
Aluminum	ug/L	17	<20	24	70	39	<5	22	34	1,000	200
Antimony	ug/L	17	<1	<1	<1	39	<0.5	<6	<6	6	--
Arsenic	ug/L	17	<2	<2	<2	39	<2	<2	5	10	--
Asbestos	MFL	--	--	--	--	6	<0.2	0.7	1.2	7	--
Barium	ug/L	17	10	125	380	39	<100	105	300	1,000	--
Beryllium	ug/L	17	<1	<1	<1	39	<0.5	<1	<1	4	--
Boron	ug/L	17	<50	118	198	22	<50	120	2,400	--	--
Cadmium	ug/L	17	<1	<1	<1	39	<0.2	<1	<1	5	--
Chromium	ug/L	17	<1	<1	2.8	39	<1	1	2.8	50	--
Chromium 6 (Hexavalent)	ug/L	15	<1	<1	2.8	17	<1	1	2.6	--	--
Cobalt	ug/L	--	--	--	--	17	<1	<1	<1	--	--
Copper[9]	ug/L	17	<1	1	8.9	34	<1	2	7.8	1,300	1,000
Iron	ug/L	17	<20	<20	81	36	<20	15	140	--	300
Lead[9]	ug/L	17	<1	<1	<1	40	<1	<1	1.1	--	--
Lithium	ug/L	17	<5	8	36	17	<5	10	27	--	--
Manganese	ug/L	17	<1	1	83	34	<1	1	150	--	50
Mercury	ug/L	16	<1	<1	<1	39	<0.5	<1	<1	2	--
Molybdenum	ug/L	17	<1	<1	<1	17	<1	<1	4.4	--	--
Nickel	ug/L	17	<1	1	2.3	39	<1	<1	5.1	100	--
Selenium	ug/L	17	<5	<5	5	39	<5	<5	5.8	50	--
Silver	ug/L	17	<1	<1	<1	33	<1	<10	<10	--	100
Thallium	ug/L	17	<1	<1	<1	39	<0.5	<1	<1	2	--
Vanadium	ug/L	17	<1	2	14	17	<1	3	14	--	--
Zinc	ug/L	17	<10	<10	78	33	<10	3.7	110	--	5,000

Table C-2 Summary of 2018 Inorganic Data (Notes)

Table includes data for wells monitored by the District (monitoring wells and water supply wells) and public water system data reported to the CA Division of Drinking Water (DDW).

Only wells with known construction information are presented in this table. DDW wells are assumed to represent the principal zone if no construction information is available, as these are typically deep

1 mg/L = milligrams per liter; ug/L = micrograms per liter; MFL = million fibers per liter.

2 The shallow aquifer zone is represented by wells primarily drawing water from depths less than 150 feet.

3 The principal aquifer zone is represented by wells primarily drawing water from depths greater than 150 feet.

4 n = number of results for each parameter. Some parameters may have been analyzed more than once at a particular well.

5 The minimum shown is the lowest detected value. The lowest reporting limit (e.g., <5) is shown when there are no quantified values at the lowest reporting limit.

6 For parameters with results with multiple reporting limits, the median was computed using the Maximum Likelihood Estimate (MLE) method.

7 MCL = Maximum Contaminant Level specified in Title 22 of the California Code of Regulations. The MCL is a health-based drinking water standard.

8 SMCL = Secondary Maximum Contaminant Level, or aesthetic-based standard, per DDW or US EPA. For SMCLs having a range, the lower, recommended threshold is listed first with the upper threshold in parentheses.

9 Lead and copper do not have primary MCLs but have "action levels" of 15 and 1,300 ppb, respectively. These substances are regulated by the state for public water systems since they can adversely affect public health.

Table C-3 Summary of 2018 Volatile Organic Compound (VOC) Data (Detect/Non-Detect)

Parameter	Units[1]	Santa Clara Subbasin, Santa Clara Plain						Santa Clara Subbasin, Coyote Valley			Llagas Subbasin						Maximum Contaminant Level	
		Shallow Zone[2]			Principal Zone[3]						Shallow Zone			Principal Zone				
		n[4]	Result[5]	RL[6]	n	Result	RL	n	Result	RL	n	Result	RL	n	Result	RL	MCL[7]	SMCL[8]
1,1,1,2-Tetrachlorethane	ug/L	1	ND	0.5	37	ND	0.5	--	--	--	2	ND	0.5	15	ND	0.5	--	--
1,1,1-Trichloroethane	ug/L	1	**D**	0.5	76	**D**	0.5	2	ND	0.5	2	ND	0.5	42	ND	0.5	200	--
1,1,2,2-Tetrachloroethane	ug/L	1	ND	0.5	76	ND	0.5	2	ND	0.5	2	ND	0.5	42	ND	0.5	1	--
1,1,2-Trichloro-1,2,2-Trifluoroethane (Freon 113)	ug/L	1	ND	10	76	ND	10	2	ND	10	2	ND	2	42	ND	10	1,200	--
1,1,2-Trichloroethane	ug/L	1	ND	0.5	76	ND	0.5	2	ND	0.5	2	ND	0.5	42	ND	0.5	5	--
1,1-Dichloroethane	ug/L	1	ND	0.5	76	ND	0.5	2	ND	0.5	2	ND	0.5	42	ND	0.5	5	--
1,1-Dichloroethene	ug/L	1	ND	0.5	76	**D**	0.5	2	ND	0.5	2	ND	0.5	42	ND	0.5	6	--
1,1-Dichloropropene	ug/L	1	ND	0.5	37	ND	0.5	--	--	--	2	ND	0.5	15	ND	0.5	--	--
1,2,3-Trichlorobenzene	ug/L	1	ND	0.5	37	ND	0.5	--	--	--	2	ND	0.5	15	ND	0.5	--	--
1,2,3-Trichloropropane	ug/L	3	ND	0.005	569	**D**	0.005	41	ND	0.01	2	ND	0.5	188	ND	0.005	0.005	--
1,2,4-Trichlorobenzene	ug/L	1	ND	0.5	76	ND	0.5	2	ND	0.5	2	ND	0.5	42	ND	0.5	--	--
1,2,4-Trimethylbenzene	ug/L	1	ND	0.5	37	ND	0.5	--	--	--	2	ND	0.5	15	ND	0.5	5	--
1,2-Dichlorobenzene	ug/L	1	ND	0.5	76	ND	0.5	2	ND	0.5	2	ND	0.5	42	ND	0.5	600	--
1,2-Dichloroethane	ug/L	1	ND	0.5	76	ND	0.5	2	ND	0.5	2	ND	0.5	42	ND	0.5	0.5	--
1,2-Dichloropropane	ug/L	1	ND	0.5	76	ND	0.5	2	ND	0.5	2	ND	0.5	42	ND	0.5	5	--
1,3,5-Trimethylbenzene	ug/L	1	ND	0.5	37	ND	0.5	--	--	--	2	ND	0.5	15	ND	0.5	--	--
1,3-Dichlorobenzene	ug/L	1	ND	0.5	37	ND	0.5	--	--	--	2	ND	0.5	15	ND	0.5	--	--
1,3-Dichloropropane	ug/L	1	ND	0.5	37	ND	0.5	--	--	--	2	ND	0.5	15	ND	0.5	--	--
1,3-Dichloropropene (Total)	ug/L	1	ND	0.5	76	ND	0.5	2	ND	0.5	2	ND	0.5	42	ND	0.5	0.5	--
1,4-Dichlorobenzene	ug/L	1	ND	0.5	76	ND	0.5	2	ND	0.5	2	ND	0.5	42	ND	0.5	5	--
1-Phenylpropane (n-Propylbenzene)	ug/L	1	ND	0.5	37	ND	0.5	--	--	--	2	ND	0.5	15	ND	0.5	--	--
2,2-Dichloropropane	ug/L	1	ND	0.5	25	ND	0.5	--	--	--	2	ND	0.5	15	ND	0.5	--	--
2,4-Dinitrotoluene	ug/L	--	--	--	11	ND	0.1	--	--	--	--	--	--	--	--	--	--	--
2,6-Dinitrotoluene	ug/L	--	--	--	1	ND	0.1	--	--	--	--	--	--	--	--	--	--	--
2-Chlorotoluene	ug/L	1	ND	0.5	37	ND	0.5	--	--	--	2	ND	0.5	15	ND	0.5	--	--
4-Chlorotoluene	ug/L	1	ND	0.5	37	ND	0.5	--	--	--	2	ND	0.5	15	ND	0.5	--	--
Benzene	ug/L	1	ND	0.5	76	ND	0.5	2	ND	0.5	2	ND	0.5	42	ND	0.5	1	--
Benzo (a) Pyrene	ug/L	--	--	--	33	ND	0.1	1	ND	0.1	--	--	--	16	ND	0.1	0.2	--
Bromobenzene	ug/L	1	ND	0.5	37	ND	0.5	--	--	--	2	ND	0.5	15	ND	0.5	--	--
Bromochloroacetic Acid (BCAA)	ug/L	--	--	--	--	--	--	--	--	--	2	ND	1	--	--	--	--	--
Bromochloromethane	ug/L	1	ND	0.5	37	ND	0.5	--	--	--	2	ND	0.5	15	ND	0.5	--	--
Bromodichloroacetic Acid (BDCAA)	ug/L	--	--	--	--	--	--	--	--	--	2	ND	1	--	--	--	--	--

Table C-3 Summary of 2018 Volatile Organic Compound (VOC) Data (Detect/Non-Detect)

Parameter	Units[1]	Santa Clara Subbasin, Santa Clara Plain						Santa Clara Subbasin, Coyote Valley			Llagas Subbasin						Maximum Contaminant Level	
		Shallow Zone[2]			Principal Zone[3]						Shallow Zone			Principal Zone				
		n[4]	Result[5]	RL[6]	n	Result	RL	n	Result	RL	n	Result	RL	n	Result	RL	MCL[7]	SMCL[8]
Bromodichloromethane (THM)	ug/L	1	ND	1	38	**D**	1	--	--	--	2	ND	0.5	15	ND	1	--	--
Bromoform (THM)	ug/L	1	ND	1	38	**D**	1	--	--	--	2	ND	0.5	15	ND	1	--	--
Bromomethane	ug/L	1	ND	0.5	22	ND	0.5	--	--	--	2	ND	0.5	15	ND	0.5	--	--
Carbon Disulfide	ug/L	1	ND	0.5	12	ND	0.5	--	--	--	--	--	--	--	--	--	--	--
Carbon Tetrachloride	ug/L	1	ND	0.5	76	ND	0.5	2	ND	0.5	2	ND	0.5	42	ND	0.5	0.5	--
Chlorodibromoacetic Acid	ug/L	--	--	--	--	--	--	--	--	--	2	ND	2	--	--	--	--	--
Chloroethane	ug/L	1	ND	0.5	25	ND	0.5	--	--	--	2	ND	0.5	15	ND	0.5	--	--
Chloroform (THM)	ug/L	1	ND	1	38	ND	1	--	--	--	2	ND	0.5	15	**D**	1	--	--
Chloromethane	ug/L	1	ND	0.5	25	ND	0.5	--	--	--	2	ND	0.5	15	ND	0.5	--	--
cis-1,2-Dichloroethene	ug/L	1	ND	0.5	76	ND	0.5	2	ND	0.5	2	ND	0.5	42	ND	0.5	6	--
Di(2-Ethylhexyl) Adipate	ug/L	--	--	--	33	ND	5	1	ND	5	--	--	--	16	ND	5	400	--
Di(2-Ethylhexyl) Phthalate	ug/L	--	--	--	33	ND	3	1	ND	3	--	--	--	16	ND	3	4	--
Dibromoacetic Acid (DBAA)	ug/L	--	--	--	--	--	--	--	--	--	2	ND	1	--	--	--	--	--
Dibromochloromethane (THM)	ug/L	1	ND	1	38	**D**	1	--	--	--	2	ND	0.5	15	ND	1	--	--
Dibromochloropropane (DBCP)	ug/L	--	--	--	51	ND	0.01	3	ND	0.01	--	--	--	18	ND	0.01	0.2	--
Dibromomethane	ug/L	1	ND	0.5	37	ND	0.5	--	--	--	2	ND	0.5	15	ND	0.5	--	--
Dichloroacetic Acid (DCAA)	ug/L	--	--	--	--	--	--	--	--	--	2	ND	1	--	--	--	--	--
Dichlorodifluoromethane (Freon 12)	ug/L	1	ND	0.5	37	ND	0.5	--	--	--	2	ND	0.5	15	ND	0.5	--	--
Dichloromethane	ug/L	1	ND	0.5	77	ND	0.5	2	ND	0.5	2	ND	0.5	42	ND	0.5	5	--
Diisopropyl Ether	ug/L	1	ND	3	37	ND	3	--	--	--	2	ND	2	15	ND	3	--	--
Ethylbenzene	ug/L	1	ND	0.5	76	ND	0.5	2	ND	0.5	2	ND	0.5	42	ND	0.5	300	--
Ethylene Dibromide (EDB)	ug/L	--	--	--	54	ND	0.02	3	ND	0.02	--	--	--	18	ND	0.02	--	--
Ethylenediamine Tetra-Acetic Acid	mg/L	--	--	--	--	--	--	--	--	--	2	ND	0.1	--	--	--	--	--
Ethyl-Tert-Butyl Ether	ug/L	1	ND	3	37	ND	3	--	--	--	2	ND	2	15	ND	3	--	--
Hexachlorobutadiene	ug/L	1	ND	0.5	37	ND	0.5	--	--	--	2	ND	0.5	15	ND	0.5	--	--
Isopropylbenzene	ug/L	1	ND	0.5	37	ND	0.5	--	--	--	2	ND	0.5	15	ND	0.5	--	--
Methyl Ethyl Ketone (MEK, Butanone)	ug/L	1	ND	5	24	ND	5	--	--	--	--	--	--	15	ND	5	--	--
Methyl Isobutyl Ketone	ug/L	1	ND	5	31	ND	5	--	--	--	--	--	--	15	ND	5	--	--
Methyl Tert-Butyl Ether (MTBE)	ug/L	1	ND	3	79	ND	3	2	ND	3	2	ND	2	42	ND	3	13	5
Monobromoacetic Acid (MBAA)	ug/L	--	--	--	--	--	--	--	--	--	2	ND	1	--	--	--	--	--
Monochloroacetic Acid (MCAA)	ug/L	--	--	--	--	--	--	--	--	--	2	ND	2	--	--	--	--	--
Monochlorobenzene	ug/L	1	ND	0.5	76	ND	0.5	2	ND	0.5	2	ND	0.5	42	ND	0.5	70	--

Table C-3 Summary of 2018 Volatile Organic Compound (VOC) Data (Detect/Non-Detect)

Parameter	Units[1]	Santa Clara Subbasin, Santa Clara Plain						Santa Clara Subbasin, Coyote Valley			Llagas Subbasin						Maximum Contaminant Level	
		Shallow Zone[2]			Principal Zone[3]						Shallow Zone			Principal Zone				
		n[4]	Result[5]	RL[6]	n	Result	RL	n	Result	RL	n	Result	RL	n	Result	RL	MCL[7]	SMCL[8]
m,p-Xylene	ug/L	1	ND	0.5	37	ND	0.5	--	--	--	2	ND	0.5	15	ND	0.5	--	--
Naphthalene	ug/L	1	ND	0.5	39	ND	0.5	--	--	--	2	ND	0.5	15	ND	0.5	--	--
n-Butylbenzene	ug/L	1	ND	0.5	37	ND	0.5	--	--	--	2	ND	0.5	15	ND	0.5	--	--
N-Ethyl Perfluorooctanesulfonamidoacetic Acid	ng/L	--	--	--	2	ND	2	--	--	--	--	--	--	--	--	--	--	--
Nitrilotriacetic Acid (NTA)	mg/L	--	--	--	--	--	--	--	--	--	2	ND	0.1	--	--	--	--	--
N-Methyl Perfluorooctanesulfonamidoacetic Acid	ng/L	--	--	--	2	ND	2	--	--	--	--	--	--	--	--	--	--	--
n-Nitrosodiethylamine (NDEA)	ug/L	--	--	--	--	--	--	--	--	--	1	ND	2	--	--	--	--	--
n-Nitrosodimethylamine (NDMA)	ug/L	--	--	--	--	--	--	--	--	--	2	ND	2	--	--	--	--	--
n-Nitrosodi-n-Butylamine (NDBA)	ug/L	--	--	--	--	--	--	--	--	--	1	**D**	NA	--	--	--	--	--
n-Nitrosodi-n-Propylamine (NDPA)	ug/L	--	--	--	--	--	--	--	--	--	1	ND	2	--	--	--	--	--
n-Nitrosomethylethylamine (NMEA)	ug/L	--	--	--	--	--	--	--	--	--	1	ND	2	--	--	--	--	--
n-Nitrosopyrrolidine (NPYR)	ug/L	--	--	--	--	--	--	--	--	--	1	ND	2	--	--	--	--	--
o-Xylene	ug/L	1	ND	0.5	37	ND	0.5	--	--	--	2	ND	0.5	15	ND	0.5	--	--
PCB-1016	ug/L	--	--	--	23	ND	0.5	3	ND	0.5	--	--	--	18	ND	0.5	--	--
PCB-1221	ug/L	--	--	--	23	ND	0.5	3	ND	0.5	--	--	--	18	ND	0.5	--	--
PCB-1232	ug/L	--	--	--	23	ND	0.5	3	ND	0.5	--	--	--	18	ND	0.5	--	--
PCB-1242	ug/L	--	--	--	23	ND	0.5	3	ND	0.5	--	--	--	18	ND	0.5	--	--
PCB-1248	ug/L	--	--	--	23	ND	0.5	3	ND	0.5	--	--	--	18	ND	0.5	--	--
PCB-1254	ug/L	--	--	--	23	ND	0.5	3	ND	0.5	--	--	--	18	ND	0.5	--	--
PCB-1260	ug/L	--	--	--	23	ND	0.5	3	ND	0.5	--	--	--	18	ND	0.5	--	--
Perfluoro Butanoic Acid (PFBA)	ng/L	--	--	--	--	--	--	--	--	--	2	ND	10	--	--	--	--	--
Perfluoro Octanesulfonate (PFOS)	ng/L	--	--	--	2	ND	40	--	--	--	2	ND	5	--	--	--	--	--
Perfluoro Octanoic Acid (PFOA)	ng/L	--	--	--	2	ND	20	--	--	--	2	**D**	NA	--	--	--	--	--
Perfluorobutanoic acid (PFBS)	ng/L	--	--	--	2	ND	1.8	--	--	--	--	--	--	--	--	--	--	--
Perfluorodecanoic acid (PFDA)	ng/L	--	--	--	2	ND	2	--	--	--	--	--	--	--	--	--	--	--
Perfluorododecanoic acid (PFDoA)	ng/L	--	--	--	2	ND	2	--	--	--	--	--	--	--	--	--	--	--
Perfluoroheptanoic acid (PFHPA)	ng/L	--	--	--	2	ND	2	--	--	--	--	--	--	--	--	--	--	--
Perfluorohexane sulfonic acid (PFHXS)	ng/L	--	--	--	2	**D**	NA	--	--	--	--	--	--	--	--	--	--	--
Perfluorohexanoic acid (PFHXA)	ng/L	--	--	--	2	**D**	NA	--	--	--	--	--	--	--	--	--	--	--
Perfluorononanoic acid (PFNA)	ng/L	--	--	--	2	ND	2	--	--	--	--	--	--	--	--	--	--	--
Perfluorotetradecanoic acid (PFTA)	ng/L	--	--	--	2	ND	2	--	--	--	--	--	--	--	--	--	--	--
Perfluorotridecanoic acid (PFTrDA)	ng/L	--	--	--	2	ND	2	--	--	--	--	--	--	--	--	--	--	--

Table C-3 Summary of 2018 Volatile Organic Compound (VOC) Data (Detect/Non-Detect)

Parameter	Units[1]	Santa Clara Subbasin, Santa Clara Plain						Santa Clara Subbasin, Coyote Valley			Llagas Subbasin						Maximum Contaminant Level	
		Shallow Zone[2]			Principal Zone[3]						Shallow Zone			Principal Zone				
		n[4]	Result[5]	RL[6]	n	Result	RL	n	Result	RL	n	Result	RL	n	Result	RL	MCL[7]	SMCL[8]
Perfluoroundecanoic Acid (PFUnA)	ng/L	--	--	--	2	ND	2	--	--	--	--	--	--	--	--	--	--	--
p-Isopropyltoluene	ug/L	1	ND	0.5	18	ND	0.5	--	--	--	2	ND	0.5	--	--	--	--	--
Polychlorinated Biphenyls (Total PCBs)	ug/L	--	--	--	29	ND	0.5	3	ND	0.5	--	--	--	18	ND	0.5	0.5	--
sec-Butylbenzene	ug/L	1	ND	0.5	37	ND	0.5	--	--	--	2	ND	0.5	15	ND	0.5	--	--
Styrene	ug/L	1	ND	0.5	76	ND	0.5	2	ND	0.5	2	ND	0.5	42	ND	0.5	100	--
Tert-Amyl Methyl Ether (TAME)	ug/L	1	ND	3	37	ND	3	--	--	--	2	ND	2	15	ND	3	--	--
Tert-Butyl Alcohol (TBA)	ug/L	--	--	--	12	ND	2	--	--	--	2	ND	2	15	ND	2	--	--
Tert-Butylbenzene	ug/L	1	ND	0.5	37	ND	0.5	--	--	--	2	ND	0.5	15	ND	0.5	--	--
Tetrachloroethene	ug/L	1	ND	0.5	76	ND	0.5	2	ND	0.5	2	ND	0.5	43	**D**	0.5	5	--
Toluene	ug/L	1	ND	0.5	76	ND	0.5	2	ND	0.5	2	ND	0.5	42	**D**	0.5	150	--
Total Trihalomethanes	ug/L	1	ND	0.5	13	**D**	NA	--	--	--	--	--	--	1	**D**	NA	80	--
trans-1,2,Dichloroethene	ug/L	1	ND	0.5	76	ND	0.5	2	ND	0.5	2	ND	0.5	42	ND	0.5	10	--
Tribromoacetic Acid	ug/L	--	--	--	--	--	--	--	--	--	1	ND	4	--	--	--	--	--
Trichloroacetic Acid (TCAA)	ug/L	--	--	--	--	--	--	--	--	--	2	ND	1	--	--	--	--	--
Trichloroethene	ug/L	1	ND	0.5	76	ND	0.5	2	ND	0.5	2	ND	0.5	42	ND	0.5	5	--
Trichlorofluoromethane (Freon 11)	ug/L	1	ND	5	76	ND	5	2	ND	5	2	ND	2.5	42	ND	5	150	--
Vinyl Chloride	ug/L	1	ND	0.5	76	ND	0.5	2	ND	0.5	2	ND	0.5	42	ND	0.5	0.5	--
Xylenes (Total)	ug/L	1	ND	0.5	13	ND	0.5	--	--	--	2	ND	0.5	--	--	--	1,750	--

Notes:

Table includes data for wells monitored by the District

Only wells with known construction information are presented. Unless construction is known, DDW wells are assumed to represent the principal zone, as these are typically deep wells.

1. ug/L = micrograms per liter.
2. The shallow aquifer zone is represented by wells primarily drawing water from depths less than 150 feet.
3. The principal aquifer zone is represented by wells primarily drawing water from depths greater than 150 feet.
4. n = number of results for each parameter. Some parameters may have been analyzed more than once at a particular well.
5. ND= not detected above laboratory reporting limit in any samples. D = detection above reporting limit in one or more samples (see Table C-4 for more information).
6. RL = Laboratory reporting limit. In the case of multiple reporting limits, the highest limit is shown. NA is shown if the reporting limit is not available.
7. MCL = Maximum Contaminant Level specified in Title 22 of the California Code of Regulations. The MCL is a health-based drinking water standard.
8. SMCL = Secondary Maximum Contaminant Level, or aesthetic-based standard, per DDW or US EPA.

Table C-4 Summary of 2018 Volatile Organic Compounds (VOCs) Detections

Parameter	Units[1]	Santa Clara Subbasin, Santa Clara Plain								Santa Clara Subbasin, Coyote Valley				Llagas Subbasin								Maximum Contaminant Level	
		Shallow Zone[2]				Principal Zone[3]								Shallow Zone				Principal Zone					
		n[4]	Min[5]	Median[6]	Max	n	Min	Median	Max	n	Min	Median	Max	n	Min	Median	Max	n	Min	Median	Max	MCL[7]	SMCL[8]
1,1,1-Trichloroethane	ug/L	1	0.92	0.92	0.92	76	<0.5	<0.5	1.1	2	<0.5	<0.5	<0.5	2	<0.5	<0.5	<0.5	42	<0.5	<0.5	<0.5	200	--
1,1-Dichloroethene	ug/L	1	<0.5	<0.5	<0.5	76	<0.5	<0.5	0.64	2	<0.5	<0.5	<0.5	2	<0.5	<0.5	<0.5	42	<0.5	<0.5	<0.5	6	--
1,2,3-Trichloropropane[9]	ug/L	3	<0.005	<0.005	<0.005	569	<0.005	<0.005	0.0116	41	<0.005	<0.005	<0.005	2	<0.5	<0.5	<0.5	188	<0.005	<0.005	<0.005	0.005	--
Bromodichloromethane (THM)	ug/L	1	<1	<1	<1	38	<1	<1	0.72	--	--	--	--	2	<0.5	<0.5	<0.5	15	<1	<1	<1	--	--
Bromoform (THM)	ug/L	1	<1	<1	<1	38	<1	<1	1.83	--	--	--	--	2	<0.5	<0.5	<0.5	15	<1	<1	<1	--	--
Chloroform (THM)	ug/L	1	<1	<1	<1	38	<1	<1	<1	--	--	--	--	2	<0.5	<0.5	<0.5	15	<1	<1	7.6	--	--
Dibromochloromethane (THM)	ug/L	1	<1	<1	<1	38	<1	<1	1.62	--	--	--	--	2	<0.5	<0.5	<0.5	15	<1	<1	<1	--	--
n-Nitrosodi-n-Butylamine (NDBA)	ug/L	--	--	--	--	--	--	--	--	--	--	--	--	1	4	4	4	--	--	--	--	--	--
Perfluoro Octanoic Acid (PFOA)	ng/L	--	--	--	--	2	<20	<20	<20	--	--	--	--	2	5.7	6.25	6.8	--	--	--	--	--	--
Perfluorohexane sulfonic acid (PFHXS)	ng/L	--	--	--	--	2	<1.8	1.95	3	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Perfluorohexanoic acid (PFHXA)	ng/L	--	--	--	--	2	<2	1.75	2.5	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Tetrachloroethene	ug/L	1	<0.5	<0.5	<0.5	76	<0.5	<0.5	<0.5	2	<0.5	<0.5	<0.5	2	<0.5	<0.5	<0.5	43	<0.5	<0.5	2.7	5	--
Toluene	ug/L	1	<0.5	<0.5	<0.5	76	<0.5	<0.5	<0.5	2	<0.5	<0.5	<0.5	2	<0.5	<0.5	<0.5	42	<0.5	<0.5	20	150	--
Total Trihalomethanes	ug/L	1	<0.5	<0.5	<0.5	13	<0.5	<0.5	4.4	--	--	--	--	--	--	--	--	1	7.6	7.6	7.6	80	--

Notes:

Table includes data for wells monitored by the District (monitoring wells and water supply wells) and public water system data reported to the CA Division of Drinking Water (DDW).

Only wells with known construction information are presented in this table. DDW wells are assumed to represent the principal zone if no construction information is available, as these are typically deep wells.

1. ug/L = micrograms per liter; ng/L = nanograms per liter.
2. The shallow aquifer zone is represented by wells primarily drawing water from depths less than 150 feet.
3. The principal aquifer zone is represented by wells primarily drawing water from depths greater than 150 feet.
4. n = number of results for each parameter. Some parameters may have been analyzed more than once at a particular well.
5. The minimum shown is the lowest detected value. The lowest reporting limit (e.g., <5) is shown when there are no quantified values at the lowest reporting limit.
6. For parameters with results with multiple reporting limits, the median was computed using the Maximum Likelihood Estimate method.
7. MCL = Maximum Contaminant Level specified in Title 22 of the California Code of Regulations. The MCL is a health-based drinking water standard.
8. SMCL = Secondary Maximum Contaminant Level, or aesthetic-based standard, per DDW or US EPA.
9. Verification sampling did not confirm the high 1,2,3-Trichloropropane result. All subsequent results were below the detection level (0.005 ppb).

Table C-5 Summary of 2018 Pesticide Data (Detect/Non-Detect)

Parameter	Units[1]	Santa Clara Subbasin, Santa Clara Plain						Santa Clara Subbasin, Coyote Valley			Llagas Subbasin						Maximum Contaminant Level	
		Shallow Zone[2]			Principal Zone[3]						Shallow Zone			Principal Zone				
		n[4]	Result[5]	RL[6]	n	Result	RL	n	Result	RL	n	Result	RL	n	Result	RL	MCL[7]	SMCL[8]
2,3,7,8-TCDD (Dioxin)	ug/L	--	--	--	29	ND	5	3	ND	5	--	--	--	18	ND	5	0.00003	--
2,4,5-TP (Silvex)	ug/L	--	--	--	31	ND	1	1	ND	1	--	--	--	17	ND	1	50	--
2,4-D	ug/L	--	--	--	31	ND	10	1	ND	10	--	--	--	17	ND	10	70	--
3-Hydroxycarbofuran	ug/L	--	--	--	29	ND	3	--	--	--	--	--	--	--	--	--	--	--
4,4-DDT	ug/L	--	--	--	--	--	--	--	--	--	--	--	--	8	ND	0.02	--	--
Acetochlor	ug/L	--	--	--	1	ND	0.1	--	--	--	--	--	--	--	--	--	--	--
Aciflurfen	ug/L	--	--	--	6	ND	0.5	--	--	--	--	--	--	--	--	--	--	--
Alachlor	ug/L	--	--	--	35	ND	1	3	ND	1	--	--	--	18	ND	1	2	--
Aldicarb	ug/L	--	--	--	29	ND	3	--	--	--	--	--	--	--	--	--	--	--
Aldicarb Sulfone	ug/L	--	--	--	29	ND	4	--	--	--	--	--	--	--	--	--	--	--
Aldicarb Sulfoxide	ug/L	--	--	--	29	ND	3	--	--	--	--	--	--	--	--	--	--	--
Aldrin	ug/L	--	--	--	30	ND	0.075	--	--	--	--	--	--	--	--	--	--	--
Atrazine	ug/L	--	--	--	33	ND	0.5	3	ND	0.5	--	--	--	18	ND	0.5	1	--
Bentazon	ug/L	--	--	--	31	ND	2	1	ND	2	--	--	--	17	ND	2	18	--
Bromacil	ug/L	--	--	--	26	ND	10	--	--	--	--	--	--	--	--	--	--	--
Butachlor	ug/L	--	--	--	26	ND	0.38	--	--	--	--	--	--	--	--	--	--	--
Carbaryl	ug/L	--	--	--	29	ND	5	--	--	--	--	--	--	--	--	--	--	--
Carbofuran	ug/L	--	--	--	29	ND	5	3	ND	5	--	--	--	18	ND	5	18	--
Chlordane	ug/L	--	--	--	29	ND	0.1	3	ND	0.1	--	--	--	18	ND	0.1	0.1	--
cis-1,3-Dichloropropene	ug/L	1	ND	0.5	12	ND	0.5	--	--	--	2	ND	0.5	--	--	--	--	--
Dalapon	ug/L	--	--	--	31	ND	10	1	ND	10	--	--	--	17	ND	10	200	--
DCPA (Total Di & Mono Acid Degradates)	ug/L	--	--	--	19	**D**	NA	--	--	--	--	--	--	--	--	--	--	--
Diazinon	ug/L	--	--	--	20	ND	0.1	--	--	--	--	--	--	--	--	--	--	--
Dicamba	ug/L	--	--	--	31	ND	1.5	--	--	--	--	--	--	9	ND	1.5	--	--
Dieldrin	ug/L	--	--	--	29	ND	0.02	--	--	--	--	--	--	--	--	--	--	--
Dimethoate	ug/L	--	--	--	20	ND	0.1	--	--	--	--	--	--	--	--	--	--	--
Dinoseb	ug/L	--	--	--	31	ND	2	1	ND	2	--	--	--	17	ND	2	7	--
Diquat	ug/L	--	--	--	29	ND	4	3	ND	4	--	--	--	18	ND	4	20	--
Endosulfan I	ug/L	--	--	--	--	--	--	--	--	--	--	--	--	8	ND	0.01	--	--
Endosulfan II	ug/L	--	--	--	--	--	--	--	--	--	--	--	--	8	ND	0.01	--	--
Endosulfan Sulfate	ug/L	--	--	--	--	--	--	--	--	--	--	--	--	8	ND	0.05	--	--
Endothall	ug/L	--	--	--	28	ND	45	3	ND	45	--	--	--	17	ND	45	100	--

Table C-5 Summary of 2018 Pesticide Data (Detect/Non-Detect)

Parameter	Units[1]	Santa Clara Subbasin, Santa Clara Plain						Santa Clara Subbasin, Coyote Valley			Llagas Subbasin						Maximum Contaminant Level	
		Shallow Zone[2]			Principal Zone[3]						Shallow Zone			Principal Zone				
		n[4]	Result[5]	RL[6]	n	Result	RL	n	Result	RL	n	Result	RL	n	Result	RL	MCL[7]	SMCL[8]
Endrin	ug/L	--	--	--	29	ND	0.1	3	ND	0.1	--	--	--	18	ND	0.1	2	--
Endrin Aldehyde	ug/L	--	--	--	--	--	--	--	--	--	--	--	--	8	ND	0.05	--	--
EPTC	ug/L	--	--	--	1	ND	0.1	--	--	--	--	--	--	--	--	--	--	--
gamma-BHC (lindane)	ug/L	--	--	--	34	ND	0.2	3	ND	0.2	--	--	--	18	ND	0.2	0.2	--
Glyphosate	ug/L	--	--	--	29	ND	25	3	ND	25	--	--	--	18	ND	25	700	--
Heptachlor	ug/L	--	--	--	29	ND	0.01	3	ND	0.01	--	--	--	18	ND	0.01	0.01	--
Heptachlor Epoxide	ug/L	--	--	--	29	ND	0.01	3	ND	0.01	--	--	--	18	ND	0.01	0.01	--
Hexachlorobenzene	ug/L	--	--	--	32	ND	0.5	3	ND	0.5	--	--	--	10	ND	0.5	1	--
Hexachlorocyclopentadiene	ug/L	--	--	--	32	ND	1	3	ND	1	--	--	--	18	ND	1	50	--
Methiocarb	ug/L	--	--	--	23	ND	0.5	--	--	--	--	--	--	--	--	--	--	--
Methomyl	ug/L	--	--	--	29	ND	2	--	--	--	--	--	--	--	--	--	--	--
Methoxychlor	ug/L	--	--	--	34	ND	10	3	ND	10	--	--	--	18	ND	10	30	--
Metolachlor	ug/L	--	--	--	20	ND	0.05	--	--	--	--	--	--	--	--	--	--	--
Metribuzin	ug/L	--	--	--	20	ND	0.05	--	--	--	--	--	--	--	--	--	--	--
Molinate	ug/L	--	--	--	33	ND	2	3	ND	2	--	--	--	17	ND	2	20	--
Oxamyl	ug/L	--	--	--	29	ND	20	3	ND	20	--	--	--	18	ND	20	50	--
Pentachlorophenol	ug/L	--	--	--	31	ND	0.2	1	ND	0.2	--	--	--	17	ND	0.2	1	--
Picloram	ug/L	--	--	--	31	ND	1	1	ND	1	--	--	--	17	ND	1	500	--
Propachlor	ug/L	--	--	--	26	ND	0.5	--	--	--	--	--	--	--	--	--	--	--
Propoxur	ug/L	--	--	--	23	ND	0.5	--	--	--	--	--	--	--	--	--	--	--
Simazine	ug/L	--	--	--	33	ND	1	3	ND	1	--	--	--	18	ND	1	4	--
Terbacil	ug/L	--	--	--	10	ND	0.1	--	--	--	--	--	--	--	--	--	--	--
Terbuthylazine	ug/L	--	--	--	--	--	--	--	--	--	1	ND	0.1	--	--	--	--	--
Thiobencarb	ug/L	--	--	--	33	ND	1	3	ND	1	--	--	--	17	ND	1	70	1
Toxaphene	ug/L	--	--	--	29	ND	1	3	ND	1	--	--	--	18	ND	1	3	--
trans-1,3,Dichloropropene	ug/L	1	ND	0.5	12	ND	0.5	--	--	--	2	ND	0.5	--	--	--	--	--

Table C-5 Summary of 2018 Pesticide Data (Detect/Non-Detect)

Parameter	Units[1]	Santa Clara Subbasin, Santa Clara Plain						Santa Clara Subbasin, Coyote Valley			Llagas Subbasin						Maximum Contaminant Level	
		Shallow Zone[2]			Principal Zone[3]						Shallow Zone			Principal Zone				
		n[4]	Result[5]	RL[6]	n	Result	RL	n	Result	RL	n	Result	RL	n	Result	RL	MCL[7]	SMCL[8]

Notes:

Table includes data for wells monitored by the District (monitoring wells and water supply wells) and public water system data reported to the CA Division of Drinking Water (DDW).

Only wells with known construction information are presented in this table. DDW wells are assumed to represent the principal zone if no construction information is available, as these are typically deep wells.

1. ug/L = micrograms per liter.
2. The shallow aquifer zone is represented by wells primarily drawing water from depths less than 150 feet.
3. The principal aquifer zone is represented by wells primarily drawing water from depths greater than 150 feet.
4. n = number of results for each parameter. Some parameters may have been analyzed more than once at a particular well.
5. ND= not detected above laboratory reporting limit in any samples.
6. RL = Laboratory reporting limit. In the case of multiple reporting limits, the highest limit is shown. NA is shown if the reporting limit is not available.
7. MCL = Maximum Contaminant Level specified in Title 22 of the California Code of Regulations. The MCL is a health-based drinking water standard.
8. SMCL = Secondary Maximum Contaminant Level, or aesthetic-based standard, per DDW or US EPA

Table C-6 Summary of 2018 Pesticide Detections

Parameter	Units[1]	Santa Clara Subbasin, Santa Clara Plain								Santa Clara Subbasin, Coyote Valley				Llagas Subbasin								Maximum Contaminant Level	
		Shallow Zone[2]				Principal Zone[3]								Shallow Zone				Principal Zone					
		n[4]	Min[5]	Median[6]	Max	n	Min	Median	Max	n	Min	Median	Max	n	Min	Median	Max	n	Min	Median	Max	MCL[7]	SMCL[8]
DCPA (Total Di & Mono Acid Degradates)	ug/L	--	--	--	--	19	<0.1	<0.1	0.13	--	--	--	--	--	--	--	--	--	--	--	--	--	--

Notes:

Table includes data for wells monitored by the District (monitoring wells and water supply wells) and public water system data reported to the CA Division of Drinking Water (DDW).

Only wells with known construction information are presented in this table. DDW wells are assumed to represent the principal zone if no construction information is available, as these are typically deep wells.

1. ug/L = micrograms per liter.
2. The shallow aquifer zone is represented by wells primarily drawing water from depths less than 150 feet.
3. The principal aquifer zone is represented by wells primarily drawing water from depths greater than 150 feet.
4. n = number of results for each parameter. Some parameters may have been analyzed more than once at a particular well.
5. The minimum shown is the lowest detected value. The lowest reporting limit (e.g., <0.1) is shown when there are no quantified values at the lowest reporting limit.
6. For parameters with results with multiple reporting limits, the median was computed using the Maximum Likelihood Estimate method.
7. MCL = Maximum Contaminant Level specified in Title 22 of the California Code of Regulations. The MCL is a health-based drinking water standard.
8. SMCL = Secondary Maximum Contaminant Level, or aesthetic-based standard, per DDW or US EPA.

Table C-7 Summary of 2018 Radioactive Data

Parameter	Units[1]	Santa Clara Subbasin, Santa Clara Plain								Santa Clara Subbasin, Coyote Valley				Llagas Subbasin								Maximum Contaminant Levels	
		Shallow Zone[2]				Principal Zone[3]								Shallow Zone				Principal Zone					
		n[4]	Min[5]	Median[6]	Max	n	Min	Median	Max	n	Min	Median	Max	n	Min	Median	Max	n	Min	Median	Max	MCL[7]	SMCL[8]
Combined Radium 226 + 228	pCi/L	--	--	--	--	2	<2	<2	<2	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Gross Alpha	pCi/L	--	--	--	--	21	<1	<3	3	--	--	--	--	--	--	--	--	1	3.02	3.02	3.02	15	--
Gross Beta	pCi/L	--	--	--	--	9	<4	<4	<4	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Radium 226	pCi/L	--	--	--	--	6	<1	<1	<1	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Radium 228	pCi/L	--	--	--	--	15	<1	<1	0.35	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Uranium	pCi/L	--	--	--	--	9	<1	<1	1.1	--	--	--	--	--	--	--	--	--	--	--	--	20	--

Notes:

Table includes data for wells monitored by the District (monitoring wells and water supply wells) and public water system data reported to the CA Division of Drinking Water (DDW).

Only wells with known construction information are presented in this table. DDW wells are assumed to represent the principal zone if no construction information is available, as these are typically deep wells.

1. pCi/L = picocuries per liter; mrem/yr = millirem per year.
2. The shallow aquifer zone is represented by wells primarily drawing water from depths less than 150 feet.
3. The principal aquifer zone is represented by wells primarily drawing water from depths greater than 150 feet.
4. n = number of results for each parameter. Some parameters may have been analyzed more than once at a particular well.
5. The minimum shown is the lowest detected value. The lowest reporting limit (e.g., <5) is shown when there are no quantified values at the lowest reporting limit.
6. For parameters with results with multiple reporting limits, the median was computed using the Maximum Likelihood Estimate (MLE) method.
7. MCL = Maximum Contaminant Level specified in Title 22 of the California Code of Regulations. The MCL is a health-based drinking water standard.
8. SMCL = Secondary Maximum Contaminant Level, or aesthetic-based standard, per DDW or US EPA.

Appendix D

2018 Recharge Water Quality Results

Table D-1 Recharge Water Quality Sampling Results – Indicator Data					
Station Name	Uvas Creek Station 1	Uvas Creek Station 2	Uvas Creek Station 3	Main Avenue Recharge Pond #2	San Pedro Recharge Pond #1
Sample Date	9/17/2018	9/17/2018	9/17/2018	9/17/2018	9/17/2018
Water Quality Indicators					
Alkalinity (total) As CaCO3	161	161	155	75	75
Alkalinity- Bicarbonate (as CaCO3)	196	197	189	41	20
Oxidation Reduction Potential	NA	119.4	NA	NA	NA
Ph- Field	NA	7.79	NA	NA	NA
Source Temperature C	NA	16.8	NA	NA	NA
Specific Conductance- Field	NA	368	NA	NA	NA
Turbidity- Field	0.92	1.88	2.35	2.43	3.04
Major and Minor Ions					
Calcium	39.8	39.5	39.2	19.4	19.8
Magnesium	20.6	20	19.4	11.8	12.2
Sodium	14.8	13.5	12.8	49.4	51.3
Potassium	1.4	1.4	1.4	3.4	3.8
Bicarbonate	196	197	189	91	91
Chloride	13	10	9	70	71
Sulfate	29	28.4	28.3	29.7	32.8
Fluoride	<0.1	<0.1	<0.1	<0.1	<0.1
Silica	17.6	16.8	15.6	11.1	5.5
Bromide	<0.05	<0.05	<0.05	0.18	0.2
TDS	236	232	214	248	248
Turbidity	0.92	1.88	2.35	2.43	3.04
Boron	98.5	88.8	91.6	130	129

Notes

1) All results reported in units of mg/L, except turbidity which has units of NTU

2) Less than "<" symbol signifies parameter is not detectable above value indicated, not to be interpreted as any specific amount present in sample

3) NA = Not Analyzed

Table D-2 Recharge Water Quality Sampling Results – Trace Elements					
Station Name	Uvas Creek Station 1	Uvas Creek Station 2	Uvas Creek Station 3	Main Avenue Recharge Pond #2	San Pedro Recharge Pond #1
Sample Date	9/17/2018	9/17/2018	9/17/2018	9/17/2018	9/17/2018
Aluminum	<20	<20	<20	<20	<20
Antimony	<1	<1	<1	<1	<1
Arsenic	<2	<2	<2	3	3
Barium	65	60	59	29	34
Beryllium	<1	<1	<1	<1	<1
Cadmium	<1	<1	<1	<1	<1
Chromium	<1	<1	<1	<1	<1
Cobalt	<1	<1	<1	<1	<1
Copper	<1	1	<1	1.5	1.2
Iron	<20	<20	<20	<20	23
Lead	<1	<1	<1	<1	<1
Lithium	<5	<5	<5	<5	<5
Manganese	6.1	4.3	4	2.4	4.8
Mercury	<1	<1	<1	<1	<1
Molybdenum	<1	<1	<1	1.3	1.8
Nickel	1.4	1.2	1.1	1	1.2
Selenium	<5	<5	<5	<5	<5
Silver	<1	<1	<1	<1	<1
Thallium	<1	<1	<1	<1	<1
Vanadium	1.1	1.2	1.6	3.6	4.4
Zinc	<10	<10	<10	<10	<10

Notes:

1) All results reported in units of ug/L

2) Less than "<" symbol signifies parameter is not detectable above value indicated, not to be interpreted as

Table D-2 Recharge Water Quality Sampling Results – Volatile Organic Contaminants					
Station Name	Uvas Creek Station 1	Uvas Creek Station 2	Uvas Creek Station 3	Main Avenue Recharge Pond #2	San Pedro Recharge Pond #1
Sample Date	9/17/2018	9/17/2018	9/17/2018	9/17/2018	9/17/2018
1,1,1,2-Tetrachlorethane	NA	NA	<0.5	NA	NA
1,1,1-Trichloroethane	NA	NA	<0.5	NA	NA
1,1,2,2-Tetrachloroethane	NA	NA	<0.5	NA	NA
1,1,2-Trichloro-1,2,2-Trifluoroethane (Freon 113)	NA	NA	<2	NA	NA
1,1,2-Trichloroethane	NA	NA	<0.5	NA	NA
1,1-Dichloroethane	NA	NA	<0.5	NA	NA
1,1-Dichloroethene	NA	NA	<0.5	NA	NA
1,1-Dichloropropene	NA	NA	<0.5	NA	NA
1,2,3-Trichlorobenzene	NA	NA	<0.5	NA	NA
1,2,3-Trichloropropane	NA	NA	<0.5	NA	NA
1,2,4-Trichlorobenzene	NA	NA	<0.5	NA	NA
1,2,4-Trimethylbenzene	NA	NA	<0.5	NA	NA
1,2-Dichlorobenzene	NA	NA	<0.5	NA	NA
1,2-Dichloroethane	NA	NA	<0.5	NA	NA
1,2-Dichloropropane	NA	NA	<0.5	NA	NA
1,3,5-Trimethylbenzene	NA	NA	<0.5	NA	NA
1,3-Dichlorobenzene	NA	NA	<0.5	NA	NA
1,3-Dichloropropane	NA	NA	<0.5	NA	NA
1,3-Dichloropropene (Total)	NA	NA	<0.5	NA	NA
1,4-Dichlorobenzene	NA	NA	<0.5	NA	NA
1-Phenylpropane (n-Propylbenzene)	NA	NA	<0.5	NA	NA
2,2-Dichloropropane	NA	NA	<0.5	NA	NA
2-Chlorotoluene	NA	NA	<0.5	NA	NA
4-Chlorotoluene	NA	NA	<0.5	NA	NA
Benzene	NA	NA	<0.5	NA	NA
Benzo (a) Pyrene	<0.1	<0.1	<0.1	NA	NA
Bromobenzene	NA	NA	<0.5	NA	NA
Carbon Tetrachloride	NA	NA	<0.5	NA	NA
Chloroethane	NA	NA	<0.5	NA	NA
Chloromethane	NA	NA	<0.5	NA	NA
cis-1,2-Dichloroethene	NA	NA	<0.5	NA	NA
Dichlorodifluoromethane (Freon 12)	NA	NA	<0.5	NA	NA
Dichloromethane	NA	NA	<0.5	NA	NA

Table D-2 Recharge Water Quality Sampling Results – Volatile Organic Contaminants					
Station Name	Uvas Creek Station 1	Uvas Creek Station 2	Uvas Creek Station 3	Main Avenue Recharge Pond #2	San Pedro Recharge Pond #1
Sample Date	9/17/2018	9/17/2018	9/17/2018	9/17/2018	9/17/2018
Diisopropyl Ether	NA	NA	<2	NA	NA
Ethylbenzene	NA	NA	<0.5	NA	NA
Ethyl-Tert-Butyl Ether	NA	NA	<2	NA	NA
Hexachlorobutadiene	NA	NA	<0.5	NA	NA
Isopropylbenzene	NA	NA	<0.5	NA	NA
m,p-Xylene	NA	NA	<0.5	NA	NA
Methyl Tert-Butyl Ether (MTBE)	NA	NA	<2	NA	NA
Monochlorobenzene	NA	NA	<0.5	NA	NA
Naphthalene	NA	NA	<0.5	NA	NA
n-Butylbenzene	NA	NA	<0.5	NA	NA
o-Xylene	NA	NA	<0.5	NA	NA
p-Isopropyltoluene	NA	NA	<0.5	NA	NA
sec-Butylbenzene	NA	NA	<0.5	NA	NA
Styrene	NA	NA	<0.5	NA	NA
Tert-Amyl Methyl Ether (TAME)	NA	NA	<2	NA	NA
Tert-Butyl Alcohol (TBA)	NA	NA	<2	NA	NA
Tert-Butylbenzene	NA	NA	<0.5	NA	NA
Tetrachloroethene	NA	NA	<0.5	NA	NA
Toluene	NA	NA	<0.5	NA	NA
trans-1,2,Dichloroethene	NA	NA	<0.5	NA	NA
Trichloroethene	NA	NA	<0.5	NA	NA
Trichlorofluoromethane (Freon 11)	NA	NA	<2.5	NA	NA
Vinyl Chloride	NA	NA	<0.5	NA	NA
Xylenes (Total)	NA	NA	<0.5	NA	NA

Notes:

1) All results reported in units of ug/L

2) Less than "<" symbol signifies parameter is not detectable above value indicated, not to be interpreted as any specific amount present in

3) NA = Not Analyzed

Table D-2 Recharge Water Quality Sampling Results – Organic Compounds					
Station Name	Uvas Creek Station 1	Uvas Creek Station 2	Uvas Creek Station 3	Main Avenue Recharge Pond #2	San Pedro Recharge Pond #1
Sample Date	9/17/2018	9/17/2018	9/17/2018	9/17/2018	9/17/2018
Alachlor	<0.25	<0.25	<0.25	NA	NA
Atrazine	<0.25	<0.25	<0.25	NA	NA
Cis-1,3-dichloropropene	NA	NA	<0.5	NA	NA
Gamma-BHC (Lindane)- Total	<0.2	<0.2	<0.2	NA	NA
Hexachlorobenzene	<0.25	<0.25	<0.25	NA	NA
Hexachlorocyclopentadiene	<0.5	<0.5	<0.5	NA	NA
Methoxychlor	<0.5	<0.5	<0.5	NA	NA
Molinate	<0.5	<0.5	<0.5	NA	NA
Simazine	<0.25	<0.25	<0.25	NA	NA
Thiobencarb	<0.25	<0.25	<0.25	NA	NA
Trans-1,3-dichloropropene	NA	NA	<0.5	NA	NA

Notes:

1) All results reported in units of ug/L

2) Less than "<" symbol signifies parameter is not detectable above value indicated, not to be interpreted as any specific amount

Appendix E

2018 Water Quality Evaluation at Recycled Water Irrigation Sites

Valley Water

TECHNICAL MEMORANDUM

2018 WATER QUALITY EVALUATION AT RECYCLED WATER IRRIGATION SITES

Prepared by:

Randy Behrens, Victoria Garcia, Jeannine Larabee

Under the Direction of:

Vanessa De La Piedra, P.E.

Unit Manager

Santa Clara Valley Water District

Groundwater Management Unit

May 2019

Introduction / Background

Valley Water partners with four recycled water producers in the county[1] to provide recycled water for non-potable purposes like landscape and agriculture irrigation and industrial processes. Tertiary treated recycled (recycled water) water generally has higher concentrations of salts, nutrients, disinfection byproducts, and emerging contaminants than local groundwater or potable treated water.[2] Previous studies near recycled water irrigation sites, including Valley Water's study discussed below, have shown that some contaminants migrate to shallow groundwater when turf and other landscaping is irrigated with tertiary treated recycled water.[3] To further understand the effects of recycled water, Valley Water conducts groundwater monitoring at 25 wells near recycled water irrigation sites and obtains additional monitoring data from South Bay Water Recycling (SBWR), a recycled water producer in San Jose.

In 2011, Valley Water completed the Recycled Water Irrigation and Groundwater (RWIG) Study,[4] which included a field study at a recycled water irrigation site, the Integrated Device Technology (IDT) campus in southeast San Jose. The RWIG study and subsequent shallow groundwater monitoring at IDT found that groundwater concentrations of most parameters did not generally increase after irrigation with recycled water. However, some constituents related to recycled water, such as PFAS and nitrosamine, were detected in multiple shallow groundwater wells. The RWIG study and current monitoring results suggest that improvement in best management practices and changes in recycled water treatment may be warranted for irrigation with recycled water in sensitive areas.

Valley Water and SBWR have worked to improve recycled water quality for irrigation and other uses. Since March 2014, recycled water provided by SBWR has been blended with advanced treated water from Valley Water's Silicon Valley Advanced Water Purification Center. The final blended recycled water has better water quality, with TDS lowered from about 750 mg/L to about 500 mg/L.

To determine the impacts to groundwater from recycled water irrigation, groundwater quality is monitored near selected recycled water irrigation sites. In addition, SBWR collects annual samples at up to 13 wells (ten wells in CY 2018) in the Santa Clara Plain as part of the City of San Jose's Groundwater Monitoring and Mitigation Program (GMMP). The location of sites selected for monitoring are depicted on Figures 1 and 2.

[1] Recycled water is produced at the Palo Alto Regional Water Quality Control Plant, San Jose/Santa Clara Water Pollution Control Plant (WPCP), the Sunnyvale WPCP and the South County Regional Wastewater Authority (SCRWA).

[2] Advanced Recycled Water Treatment Feasibility Project, Black & Veatch, Kennedy/Jenks for the Santa Clara Valley Water District, August 2003. In the Llagas subbasin, nutrient content of recycled water is lower than ambient groundwater concentrations (Llagas Subbasin Salt and Nutrient Management Plan).

[3] California GAMA Program: Fate and Transport of Wastewater Indicators: Results from Ambient Groundwater and from Groundwater Directly Influenced by Wastewater, Lawrence Livermore National Laboratory and California State Water Resources Control Board, June 2006.

[4] Locus Technologies for Santa Clara Valley Water District, Recycled Water Irrigation and Groundwater Study, Santa Clara and Llagas Groundwater Subbasins, Santa Clara County, California, August 2011.

Valley Water evaluates data collected by SBWR and data from its own sites in both the Santa Clara Plain and the Llagas Subbasin. Statistical analysis of concentration trends and other geochemical analytical methods are used to evaluate water quality changes as summarized below for each subbasin.

Santa Clara Subbasin

Both SBWR and Valley Water monitor for the effects of recycled water irrigation on groundwater in the Santa Clara Plain (Figure 1). The parameters analyzed by SBWR include basic salts and minerals, alkalinity and TDS. Valley Water analyzes the IDT well water for basic quality parameters, ions, disinfection byproducts (DBPs), PFAS, NDMA, bacterial parameters, and other parameters commonly encountered in recycled water.

Integrated Device Technology (IDT) Site

In May 2018, the four IDT monitoring wells and the irrigation source water were sampled for a variety of parameters. NDMA and other disinfection byproducts can form during recycled water treatment and within pipelines.[5] NDMA was detected in the IDT irrigation supply water at 400 nanograms per liter (ng/L). This value is within the historic range observed in recycled water used at IDT (200 to 680 ng/L from 2008 to 2018, with a median of 375 ng/L) but exceeds the notification level of 10 ng/L established for drinking water. IDT irrigation water and shallow groundwater at the site are not used for drinking water. Like 2017 but in contrast to previous years, NDMA was not detected in any of the four IDT wells during the 2018 sampling event. The maximum level of NDMA ever detected was in September 2013 in shallow groundwater at a concentration of 18 ng/L. Various other nitrosamine compounds have been detected periodically at low concentrations.

Trihalomethanes (THMs) and halo acetic acids (HAAs) can also form because of water treatment processes. Analyses for these compounds shows that THMs are present in the source water and groundwater; however, the levels detected in groundwater are well below the maximum allowable amount for drinking water supplies. HAAs are present in very low concentrations in the irrigation source water but non-detectable in groundwater at the site.

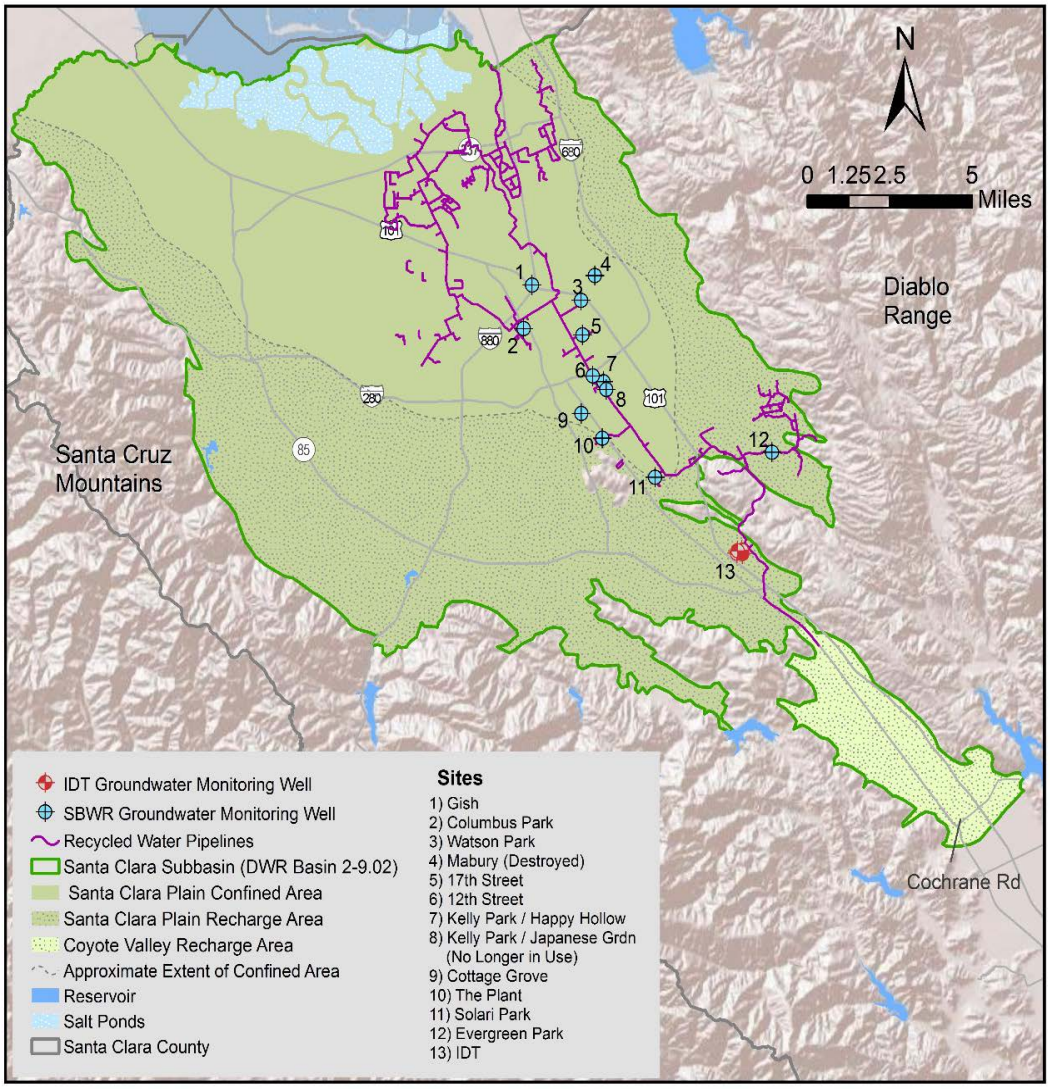
Three of the major PFAS (Perfluorobutanoic Acid (PFBA), Perfluorooctanoic Acid (PFOA), and Pefluorooctane Sulfonate (PFOS) have historically been detected at low levels in IDT irrigation source water and sporadically in groundwater; however, none of these compounds were detected in shallow groundwater wells during the May 2018 sampling event. In 2016, the EPA issued a health advisory recommending that the combined levels of PFOA and PFOS not exceed 70 ng/L in drinking water.[6] California does not have a public health goal or regulatory standard for any PFAS in drinking water. However, in August 2019, the California Division of Drinking Water (DDW) established notification levels at concentrations of 6.5 ng/L for PFOS and 5.1 ng/L for PFOA, consistent with recommendations from the Office of Environmental Health Hazard Assessment (OEHHA). Per the DDW website: "Notification levels are a non-regulatory, precautionary health-based measure for concentrations in

[5] Monochloramine, a disinfection byproduct, can react with certain forms of organic nitrogen that contains precursors to produce NDMA.

[6] US EPA, "Fact Sheet: PFOA and PFOS Drinking Water Advisories". https://www.epa.gov/sites/production/files/2016-06/documents/drinkingwaterhealthadvisories_pfoa_pfos_updated_5.31.16.pdf November, 2016.

drinking water that warrant notification and further monitoring and assessment."[7] Some historic detections of these compounds in groundwater at the site have been over the DDW notification levels. Groundwater monitoring results for 2018 are presented in Table E-1.

Figure E-1. Groundwater Monitoring Near Santa Clara Subbasin Recycled Water Irrigation Sites



Fifteen parameters were analyzed for trend using a quantitative statistical procedure known as Kendall's tau. The period examined for trend is variable, beginning at the start of the available record for each monitoring program. SBWR data cover a period of approximately 20 years and IDT spans an 11-year period. The 15 parameters chosen for trend are the common ions, TDS, and select waste-water indicators. Results show increasing concentrations of TDS, calcium, magnesium, potassium, chloride, sulfate, bicarbonate, and bromide in one well near the turf grass area. The other three wells, located in the parking lot, exhibit generally stable or

Piper diagrams offer an effective tool in understanding sources of dissolved parameters in water, modifications in the character of a water over time, and whether mixing of two waters is occurring (see Figure E-2 for more explanation). Of the four IDT wells, three show little evidence that recycled water is mixing with native groundwater. The quality of the one well near the turf grass area, however, shows evidence that recycled water may be mixing with native groundwater because its composition is evolving to be chloride dominant. The chloride content of this well water has slowly increased from about 30 mg/L to almost 100 mg/L over the 11 years the site has been monitored.

The observed upward concentration trends of numerous water quality constituents and the presence of potential wastewater indicators like PFAS and nitrosamines warrants continued monitoring and analysis of the data derived.

South Bay Water Recycling Groundwater Monitoring and Mitigation Program Wells

The SBWR monitoring program consists of four (previously six) deep water supply wells and six shallow monitoring wells. The shallow wells range in depth from 38 to 63 feet below ground surface. The deep wells all have depths greater than 600 feet with multiple perforated intervals. Two deep water wells were destroyed in 2018; results from these wells are included in this report but will not be available in the future. The SBWR monitoring program does not include analyses for wastewater indicators such as PFAS or NDMA which makes it more challenging to assess potential impacts.

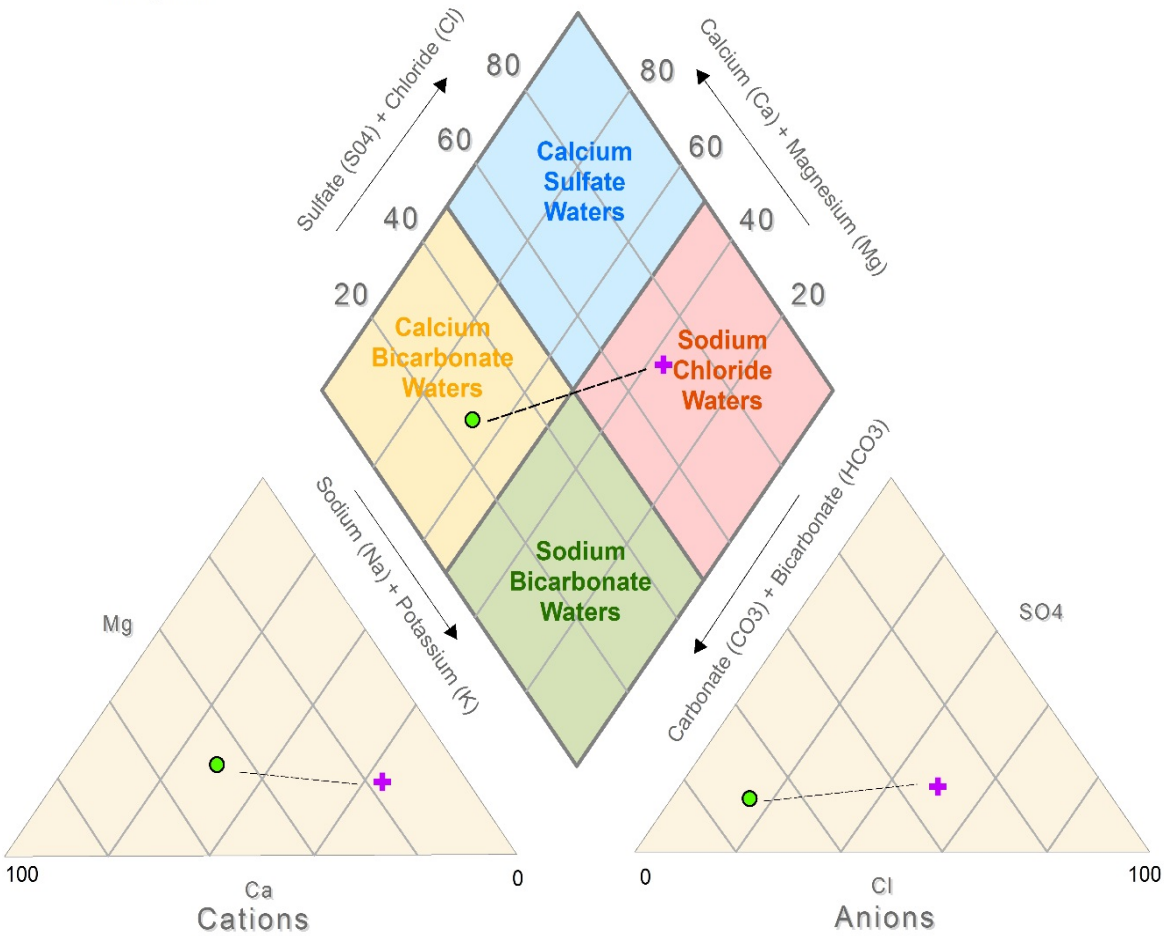
Concentration trend results for the deep wells show increasing concentrations for chloride and nitrate in four of the six wells and increasing concentrations for calcium and magnesium in three wells. TDS concentrations are stable in all deep wells except for one, which shows decreasing concentrations. It is likely that upward concentration trends in the deep wells were established before the advent of recycled water irrigation. Increasing concentrations in the deep aquifer zone within the interior portion of the basin are more likely the result of contaminants moving along much longer flow paths originating in the forebay zone rather than vertical flow paths from the irrigation sites.

Trend study results for the six shallow wells show upward concentration trends for sodium in five of the six shallow wells and chloride is increasing in all but two shallow wells. Increased concentrations of TDS are observed at two sites. Nitrate concentration trends were either stable or downward for all sites. Detailed well-by-well trend results are provided below in Table E-2.

Piper diagram analysis indicates mixing between groundwater and recycled water is not evident in samples collected from all six deep wells. Some evolution of water composition is noted at several shallow well sites; however, simple mixing is not observed, indicating other processes such as adsorption or precipitation are occurring. Thus, changes in quality in these shallow wells may be related to recycled water use; however, other processes also affect water quality., A combination of mixing and geochemical reactions tends to arrest changes in cation composition but not anion composition. This pattern can be seen at the following sites: Evergreen Park, Happy Hollow, The Plant, and Solari Park. A representative piper diagram (Evergreen Park) which illustrates this phenomenon nicely is provided below as Figure E-3.

The piper diagram for Columbus Park shows that its water quality, which was rather poor prior to recycled water irrigation, could not have resulted from the mixing of native groundwater and recycled water. Therefore, the degraded water quality at this site doesn't seem related to, or affected by, recycled water irrigation. The source and timing of degradation at this site is currently unknown. A similar condition was also observed at the Watson Park Site.

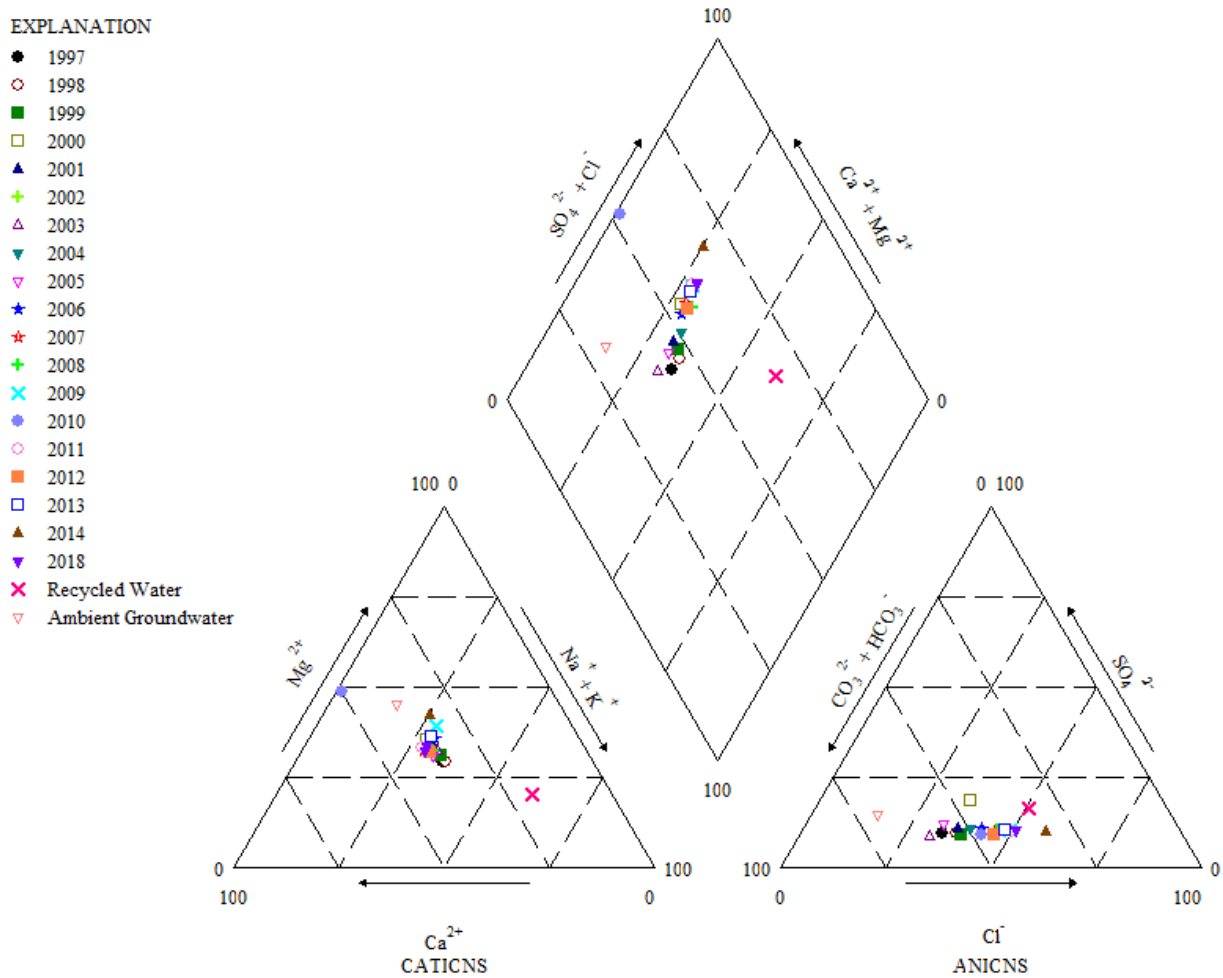
The remainder of this page is intentionally left blank



In 1944 Arthur M. Piper developed a means by which a water analysis can be represented by a single plotting position in a trilinear diagram. This is possible because to a very large extent, the majority of dissolved matter in natural water consists of three cations (calcium, magnesium, and sodium) and three anions (bicarbonate, chloride, sulfate). Chemical equilibrium results in an equal amount of cations and anions so that electrical charge remains balanced, therefore, the sum of cations is 50% of the total and same for anions. The key features of a chemical analyses is indicated by the location of the point in the center diamond. Mixing between two waters will plot on a line connecting the two end-members. Hence, the line connecting two end-members is known as the mixing line. Simple mixtures will plot along this line. When one or more parameters is removed by precipitation or sorption reactions, the resulting mixture will not fall on the theoretical mixing line.

In the diagram above, two water analyses appear in the center diamond. One sample (purple cross) represents recycled water and the other sample (green dot) represents fresh groundwater. Various mixtures of these waters will plot on the line connecting the two dots.

Figure E-3 Piper Diagram Evergreen Park, Santa Clara Subbasin



Piper Diagram showing composition of recycled water and that of shallow groundwater during the period from 1997 to 2018. Note in triangle plot in lower right (ANIONS) how data have spread since 1997 (black dot) toward the recycled water end-member (red X). Plot locations in the lower left triangle (CATIONS) stay more consistent over time.

Table E-1 Summary of 2018 Groundwater Data from Santa Clara Subbasin Recycled Water Irrigation Sites

Parameter	Units	Santa Clara Subbasin, Santa Clara Plain				Maximum Contaminant Level	
		n	Min	Median	Max	MCL	SMCL
Major and Minor Ions							
Bicarbonate Alkalinity (as CaCO3)	mg/L	14	110	385	680	--	--
Bromide	mg/L	4	0.06	0.15	0.28	--	--
Calcium	mg/L	14	16	88	425	--	--
Chloride	mg/L	14	24.5	92	470	--	250
Cyanide	mg/L	4	<0.1	<0.1	<0.1	150	--
Magnesium	mg/L	14	13	64	200	--	--
Potassium	mg/L	14	0.32	1.30	5.75	--	--
Sodium	mg/L	14	18.7	42.0	250	--	--
Sulfate	mg/L	19	34.4	68.0	955	--	250
Total Dissolved Solids (TDS)	mg/L	19	200	520	2,050	--	500
Nutrients							
Nitrate (as N)	mg/L	19	<0.2	2.4	7.3	10	--
Orthophosphate (Dissolved, as P)	mg/L	5	0.06	0.09	0.12	--	--
Phosphate	mg/L	4	<0.1	<0.1	<0.1	--	--
Trace Elements							
Aluminum	ug/L	5	27	31	100	1,000	200
Antimony	ug/L	5	<1	<1	<1	6	--
Arsenic	ug/L	5	<2	<2	<2	10	--
Barium	ug/L	5	40	61	79	1,000	--
Beryllium	ug/L	5	<1	<1	<1	4	--
Boron	mg/L	19	<0.06	0.28	122	--	--
Cadmium	ug/L	5	<1	<1	<1	5	--
Chromium	ug/L	5	<1	1.1	1.6	50	--
Cobalt	ug/L	5	<1	<1	<1	--	--
Copper	ug/L	5	<1	1.3	4	--	1,000
Iron	ug/L	5	<20	<20	72	--	300
Lead	ug/L	5	<1	<1	<1	--	--
Lithium	ug/L	5	<5	<5	5.9	--	--
Manganese	ug/L	5	<1	1.3	10.3	--	50
Mercury	ug/L	5	<1	<1	<1	2	--
Molybdenum	ug/L	5	<1	<1	1.2	--	--
Nickel	ug/L	5	<1	<1	<1	100	--
Selenium	ug/L	5	<5	<5	<5	50	--
Silver	ug/L	5	<1	<1	<1	--	100
Thallium	ug/L	5	<1	<1	<1	2	--
Vanadium	ug/L	5	1.2	1.8	2.6	--	--
Zinc	ug/L	5	<10	<10	<10	--	5,000

Table E-1 Summary of 2018 Groundwater Data from Santa Clara Subbasin Recycled Water Irrigation Sites (continued)

Parameter	Units	Santa Clara Subbasin, Santa Clara Plain				Maximum Contaminant Level	
		n	Min	Median	Max	MCL	SMCL
Organic Compounds							
Bromochloroacetic Acid (BCAA)	ug/L	5	<1	<1	<1	--	--
Bromochloromethane	ug/L	9	<0.5	<0.5	<0.5	--	--
Bromodichloroacetic Acid	ug/L	5	<1	<1	<1	--	--
Bromodichloromethane (THM)	ug/L	9	<0.5	<0.5	<1	--	--
Bromoform (THM)	ug/L	9	<0.5	<0.5	<1	--	--
Bromomethane	ug/L	9	<0.5	<0.5	<0.5	--	--
Chlorodibromoacetic Acid	ug/L	5	<2	<2	<2	--	--
Chloroform (THM)	ug/L	9	<0.5	<0.5	<1	--	--
Dibromoacetic Acid (DBAA)	ug/L	9	<0.22	<1	<1	--	--
Dibromochloromethane (THM)	ug/L	9	<0.5	<0.5	<1	--	--
Dibromomethane	ug/L	9	<0.5	<0.5	<0.5	--	--
Dichloroacetic Acid (DCAA)	ug/L	9	<0.32	<1	<0.32	--	--
Haloacetic Acids (HAA5)	ug/L	9	<0.5	<0.5	<2	60	--
Monobromoacetic Acid (MBAA)	ug/L	9	<0.32	<1	<1	--	--
Monochloroacetic Acid (MCAA)	ug/L	9	<0.34	<2	<2	--	--
n-Nitrosodiethylamine (NDEA)	ng/L	9	<2	<2	<2	--	--
n-Nitrosodimethylamine (NDMA)	ng/L	9	<2	<2	<2	--	--
n-Nitrosodi-n-Butylamine (NDBA)	ng/L	9	<2	<2	6.1	--	--
n-Nitrosodi-n-Propylamine	ng/L	9	<2	<2	<2	--	--
n-Nitrosomethylethylamine	ng/L	9	<2	<2	<2	--	--
n-Nitrosopyrrolidine (NPYR)	ng/L	9	<2	<2	<2	--	--
Perfluoro Butanoic Acid (PFBA)	ng/L	9	<10	<10	<10	--	--
Perfluoro Octanesulfonate (PFOS)	ng/L	9	<5	<5	7.4	--	--
Perfluoro Octanoic Acid (PFOA)	ng/L	9	<5	<5	9.8	--	--
Total Trihalomethanes	ug/L	4	<0.5	<0.5	<0.5	80	--
Trichloroacetic Acid (TCAA)	ug/L	9	<0.26	<1	<1	--	--

Notes:

1. Table includes data for wells near areas irrigated with water from South Bay Water Recycling (SBWR).
2. n = the number of results for parameter
3. mg/L = milligrams per liter; ug/L = micrograms per liter; ng/L = nanograms per liter.
4. The minimum shown is the lowest detected value. The lowest reporting limit is shown (e.g., <5) when there are no quantified values at the lowest reporting limit.
5. For parameters with results less than multiple reporting limits, the median was computed using the Maximum Likelihood Estimate (MLE) method.
6. MCL = Maximum Contaminant Level as specified in Title 22 of the California Code of Regulations. The MCL is a health-based drinking water standard.
7. SMCL = Secondary Maximum Contaminant Level, or aesthetic-based standard per DDW or US EPA.

Table E-2 Trend Result Summary - Santa Clara Subbasin

Well ID	Site	Aquifer Zone	Well Depth	Trend Period (yr)[2]	Trend Result[1]														
					TDS	Ca	Mg	Na	K	Cl	SO_4	NO_3	Br	HCO_3	NDMA	NDBA	PFOA	PFOS	PFBA
IDT																			
08S02E07A014	MW#3	Shallow	45	11.0	up	up	up	--[3]	up	up	--	--	up	up	--	--	--	--	--
08S02E07A015	IDT	Shallow	45	11.0	--	--	--	--	--	--	down	down	--	--	--	--	--	--	--
08S02E08D011	IDT	Shallow	45	11.0	--	--	--	--	--	up	--	--	--	--	--	--	--	--	--
08S02E08D012	IDT	Shallow	45	11.0	--	--	--	--	--	--	--	down	--	--	--	--	--	--	--
South Bay Water Recycling																			
06S01E31K001	Gish	Deep	752	20.6	--	up	up	--	--	--	up	up	NA[4]	down	NA	NA	NA	NA	NA
07S01E09D008	17th	Deep	0	20.6	--	--	--	--	--	up	--	up	NA	--	NA	NA	NA	NA	NA
07S01E16C006	12th	Deep	0	20.6	--	up	up	up	--	up	down	up	NA	--	NA	NA	NA	NA	NA
07S01E16J001	Kelly Park	Deep	0	17.9	down	--	--	--	--	up	down	--	NA	down	NA	NA	NA	NA	NA
07S01E21E003	Cottage	Deep	0	20.6	--	up	up	--	--	up	--	up	NA	--	NA	NA	NA	NA	NA
06S01E33F006	Mabury	Deep	651	16.6	--	--	--	--	--	--	--	--	NA	--	NA	NA	NA	NA	NA
07S01E07D031	Columbus	Shallow	38.5	20.6	--	--	--	up	up	up	--	--	NA	--	NA	NA	NA	NA	NA
07S01E16G019	Happy Hollow	Shallow	51.5	20.6	--	down	--	--	--	up	--	--	NA	down	NA	NA	NA	NA	NA
07S01E28C002	The Plant	Shallow	92	20.6	up	--	--	up	down	up	up	--	NA	--	NA	NA	NA	NA	NA
07S01E35D003	Solari	Shallow	63.5	20.6	--	--	--	up	--	--	--	down	NA	--	NA	NA	NA	NA	NA
07S02E29H005	Evergreen	Shallow	59.5	20.6	up	up	up	up	up	up	up	down	NA	--	NA	NA	NA	NA	NA
07S01E04D004	Watson	Shallow	40	20.6	--	up	--	up	up	--	--	--	NA	down	NA	NA	NA	NA	NA

Notes:

1) Trend test used is Kendal's trend test, minimum number of samples needed is n = 4, test is conducted at 95% confidence using standard hypothesis test structure
2) Trend Period is the number of years of record for each station used in the trend analysis
3) The symbol "—" indicates no significant trend at 95% confidence using Kendal's trend test
4) "NA" indicates constituent not analyzed and no data are available for trend testing
5) This trend record is assembled from two different monitoring wells at the same site, one replacing the other. The Well ID stated is of the surviving well.

Llagas Subbasin

Recycled water used in the Llagas Subbasin is tertiary treated wastewater that is produced by the SCRWA facility and then distributed to several locations in Gilroy (Figure E-4). Valley Water monitors groundwater in 20 wells at six recycled water irrigation sites. The sites monitored are: Christmas Hill Park, SCRWA Facility, McCarthy Ranch, Princevalle Drain, Sports Park, and Third Street Park. Water samples are analyzed for basic water quality parameters, ions, DBPs, PFAS, NDMA, bacterial parameters, and other parameters commonly encountered in recycled water. The data collected during 2018 are summarized below in Table E-3. All wells sampled in 2018 were monitoring wells, which are not used for drinking water. However, the presence of PFAS in several monitoring wells above recently established DDW drinking water notification levels is of concern and warrants further evaluation.

Due to the widespread use of PFAS in industrial and consumer applications, DDW is mandating testing of various public water systems to better understand the occurrence of PFAS in drinking water. Valley Water will continue to work with the state and with local water retailers to better understand the presence and potential sources of PFAS in local water supplies and to take action if needed to ensure a safe and reliable drinking water supply. To support this, Valley Water is exploring additional monitoring and our water quality laboratory is preparing to obtain state certification to test for PFAS in drinking water.

Christmas Hill Park

Groundwater monitoring at Christmas Hill Park has been ongoing since 2003, which roughly coincides with the first deliveries of recycled water to the site and consists of three shallow monitoring wells near turf grass areas and one deeper well. Despite its presence in recycled water supplied to the park, NDMA was not detected in groundwater during both sampling events of 2018. There have been 2 detections of NDMA in the shallow groundwater monitoring wells at the site, both in 2012. At that time, there were several other nitrosamine compounds detected. Since then there have been almost no detections of NDMA or other nitrosamine compounds in groundwater. There have been no detections of nitrosamine compounds in the deep monitoring well.

PFAS have been consistently detected at the site in the three shallow monitoring wells in relatively low levels (maximum of 35 ng/L) since they were first tested for in 2012. Since PFAS are potential wastewater indicators, these detections could indicate some impact to shallow groundwater. No PFAS have been detected in the deep monitoring well.

Piper diagram analysis of the data collected indicate the three wells have stable ionic composition over time. Some small changes in quality can be seen at one shallow monitoring well. Figure E-5, below, shows a Piper Diagram of a monitoring well with no apparent effects of recycled water irrigation on ambient shallow groundwater quality.

Mann-Kendall trend analysis shows that all three of the shallow monitoring wells had statistically significant upward concentration trends for at least one of the following parameters: potassium, chloride, and sulfate. No other increases were observed among the shallow wells. Trend results are summarized in Table E-4 below.

Irrigated Land Near SCRWA Facility

The SCRWA Facility is surrounded by farmlands which are in active production. Some of the lands are irrigated with recycled water. Monitoring for potential wastewater indicators and basic water quality parameters has been ongoing since about 2003. The current monitoring network at the site consists of four wells; three shallow and one deeper monitoring well. The three shallow wells are about 40 feet deep whereas the deeper well is 120 feet deep. The two main potential wastewater indicator types that are used to assess impacts to the shallow groundwater are DBPs, including NDMA and other nitrosamines, and PFAS. Nitrosamine compounds have been detected recently and historically in groundwater at this site. Most recently, NDMA and one other nitrosamine compound were detected in all four monitoring wells at low levels of about 3 ng/L. Historically, nitrosamine compounds, free chlorine, and other DBPs have been detected in groundwater at the site in low levels, likely indicating combined effects of recycled water irrigation and land disposal of secondary plant effluent.

PFAS have been regularly detected in all SCRWA wells since monitoring for these parameters began in 2012. PFOA and PFOS levels are the highest at the SCRWA facility with a maximum concentration of 61 ng/L and 100 ng/L, respectively. The combined levels of PFOA and PFOS detected in 2018 in the three shallow wells had a median value of 116 ng/L, exceeding the EPA's 70 ng/L health advisory. Shallow groundwater at the SCRWA site is not used for drinking water. Each of the three wells were sampled twice in 2018. Notably, PFOA and PFOS were both present in the deeper well (110 feet deep) at the SCRWA site. This well was also sampled twice in 2018, and the median combined concentration was 28.5 ng/L. This suggests the possible downward migration of PFOA and PFOS into the shallow aquifer and then the deeper aquifer. These detections and widespread occurrence of oxygen rich groundwater at depth indicates less natural protection in this part of the Llagas Subbasin as compared to the Santa Clara Plain. It does not appear that the concentrations of PFOA and PFOS are increasing over time in these wells but a general pattern of a higher concentration of PFAS in the three shallow wells relative to the deep well appears to be present.

Piper diagram analysis of monitoring data indicate the three shallow wells have ionic compositions almost identical to recycled water. Figure E-6, below, provides a representative piper diagram showing this condition. It suggests that alteration of groundwater quality had already occurred before the application of recycled water for agriculture and prior to commencement of monitoring. Most likely, historic and current on-site disposal of secondary wastewater effluent is the primary cause of shallow groundwater degradation.

Upward trends of potassium concentrations are noted in the three shallow wells at the SCRWA facility. This is further evidence of some impacts by recycled water and secondary wastewater effluent disposal as its potassium content is much greater than typical groundwater concentrations. Most all other parameters subjected to trend testing did not display any significant increases or decreases

McCarthy Ranch

The McCarthy Ranch farmland is outside the limits of the SCRWA facility yet close in geographic proximity. Two monitoring wells were installed in 2015 to monitor the shallow groundwater quality from recycled water used to irrigate a variety of crops. DBPs detected at the site include NDMA at concentrations of up to 3.4 ng/L and various HAAs.

Various PFAS were also detected in shallow groundwater. The detections of these compounds have been consistent since monitoring began with an average concentration of about 10 ng/L. Historically, a few higher concentration samples were observed, which may be related to drought years.

No clear pattern is discernable on the Piper diagrams for the SCRWA and McCarthy Ranch monitoring sites. Some evolution of water composition is noticed; however, a signature of "mixing" with recycled water is not apparent. These wells have been monitored for about four years, so it may take more time to see changes with respect to common ions.

No statistically significant trends were detected in monitoring data at both wells.

Princevalle Drain

The Princevalle Drain site is not a location of recycled water usage, rather, it consists of two shallow monitoring wells located along the recycled water pipeline which is aligned parallel to a drainage ditch. Only one nitrosamine compound was detected in 2014, however, PFAS have been detected consistently at concentrations between 8 and 98 ng/L. The source of these potential wastewater indicators is unknown.

Piper diagram analysis of one of the monitoring wells shows little to no influence of recycled water on shallow groundwater quality. The other monitoring well has been mostly dry since monitoring began at the site and insufficient data are available for plotting.

No significant trends were observed for the one monitoring well that had sufficient data for testing. More monitoring at this site is needed to better understand the quality of groundwater and sources of contaminants.

Sports Park

Four monitoring wells that were installed in 2016 have been sampled quarterly for the first two years and now are monitored twice annually. The site consists of several turf grass sporting fields for community use. The turf grass and landscaped portions of the site are irrigated with recycled water. DBPs, including nitrosamine compounds and HAASs, are detected in the monitoring wells at very low levels (e.g., <2.5 ng/L and <2 ug/L, respectively). PFOS is detected in two of the monitoring wells at concentrations of about 5 ng/L.

Little to no evidence of mixing is evident in the piper diagrams prepared for this site. No significant trends were detected for all water quality parameters tested.

Third Street Park

This site consists primarily of turf grass and landscaped areas in a new residential area located on the western edge of Gilroy. Four monitoring wells that were installed in 2016 have been monitored quarterly for the first two years and now are monitored twice annually. DBPs, including one nitrosamine compound (NDBA) and HAAs, were detected in the monitoring wells at very low levels. PFOA was detected in one of the monitoring wells at concentrations of about 10 ng/L. More monitoring is needed at this site to confirm these detections as legitimate.

Some evidence of early mixing with recycled water is evident in the piper diagram prepared for three of the onsite monitoring wells, though the signature is not one of simple mixing like as seen at other sites. A

Figure E-4. Groundwater Monitoring Near Llagas Subbasin Recycled Water Irrigation Sites

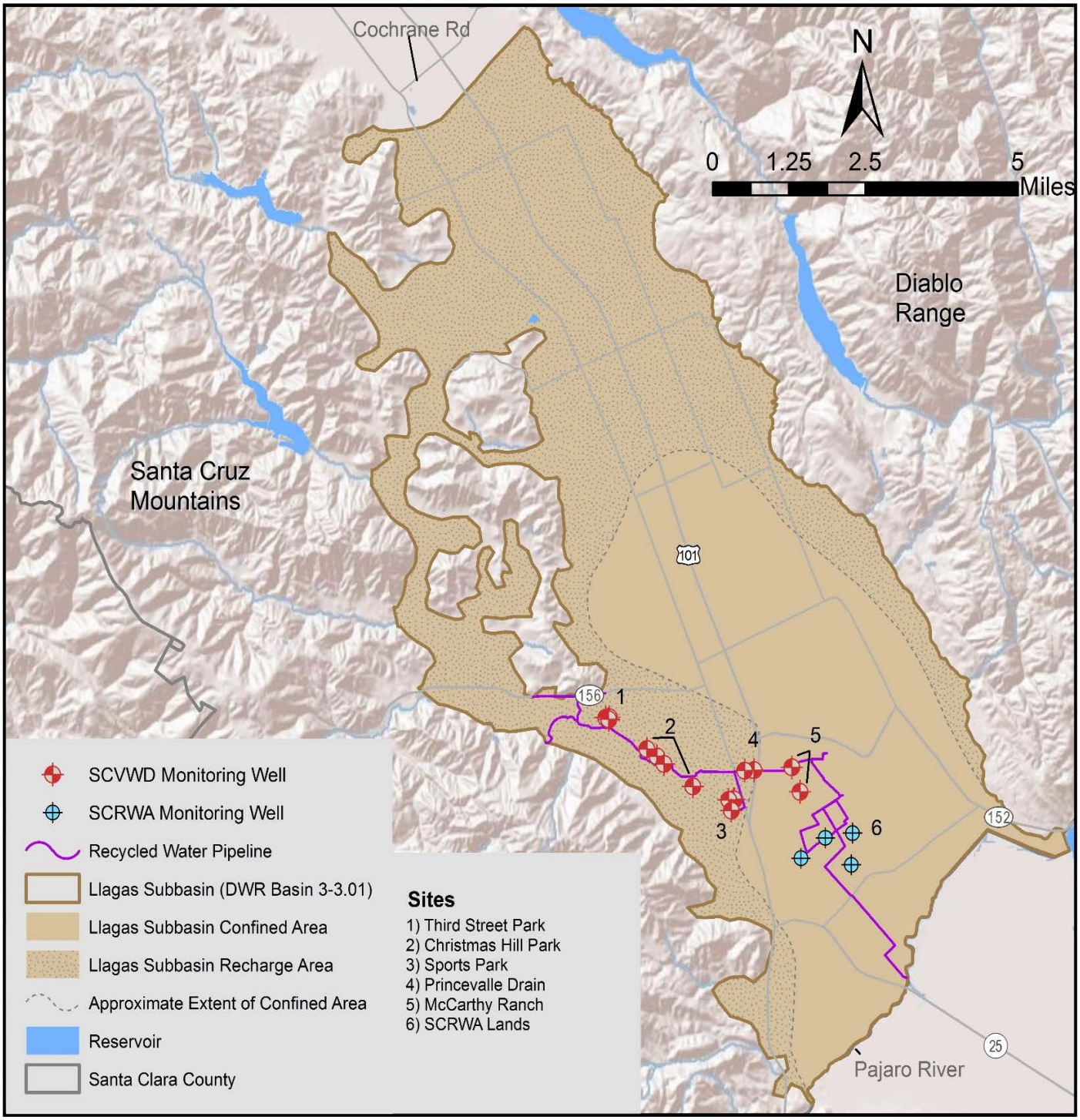
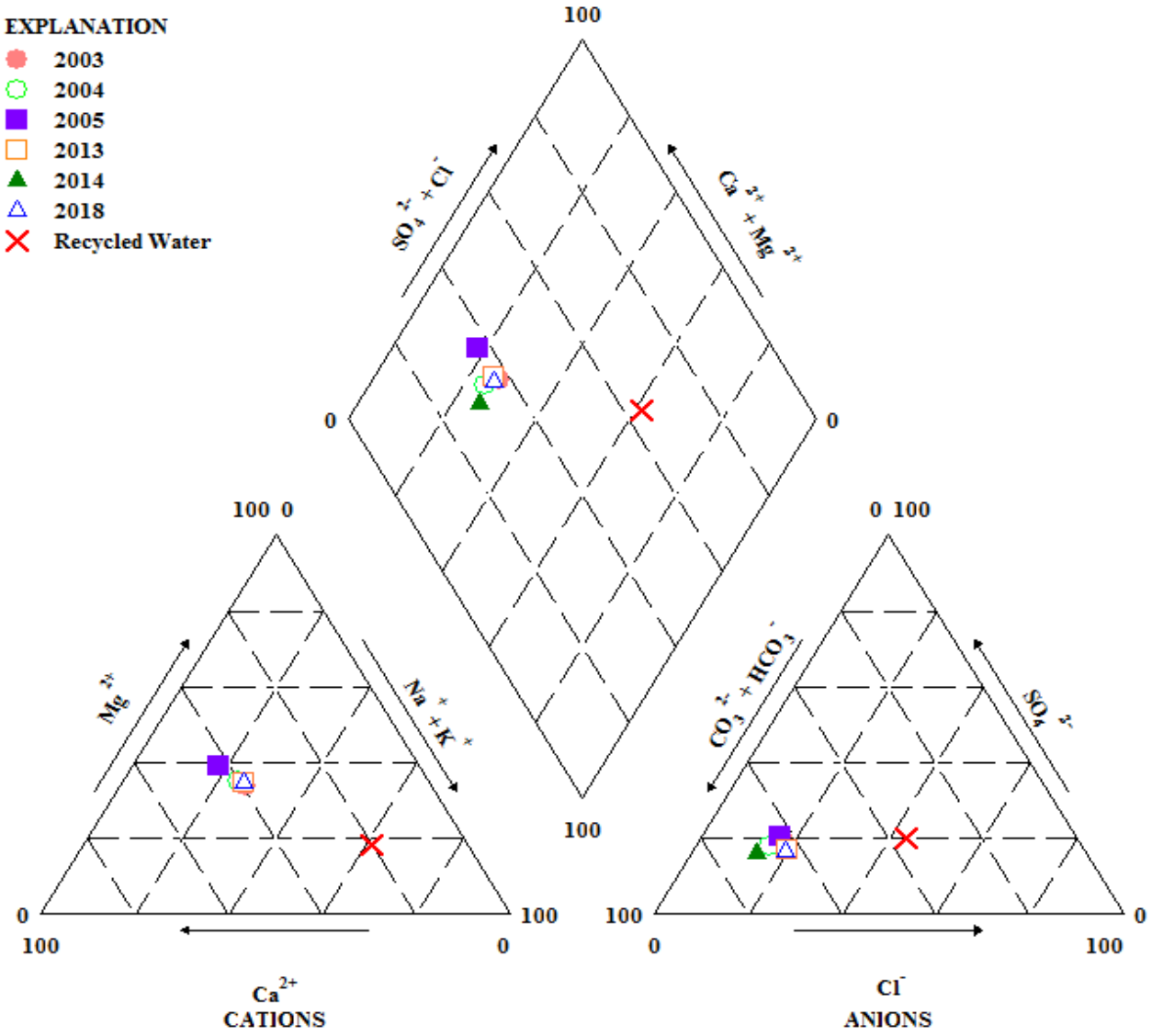
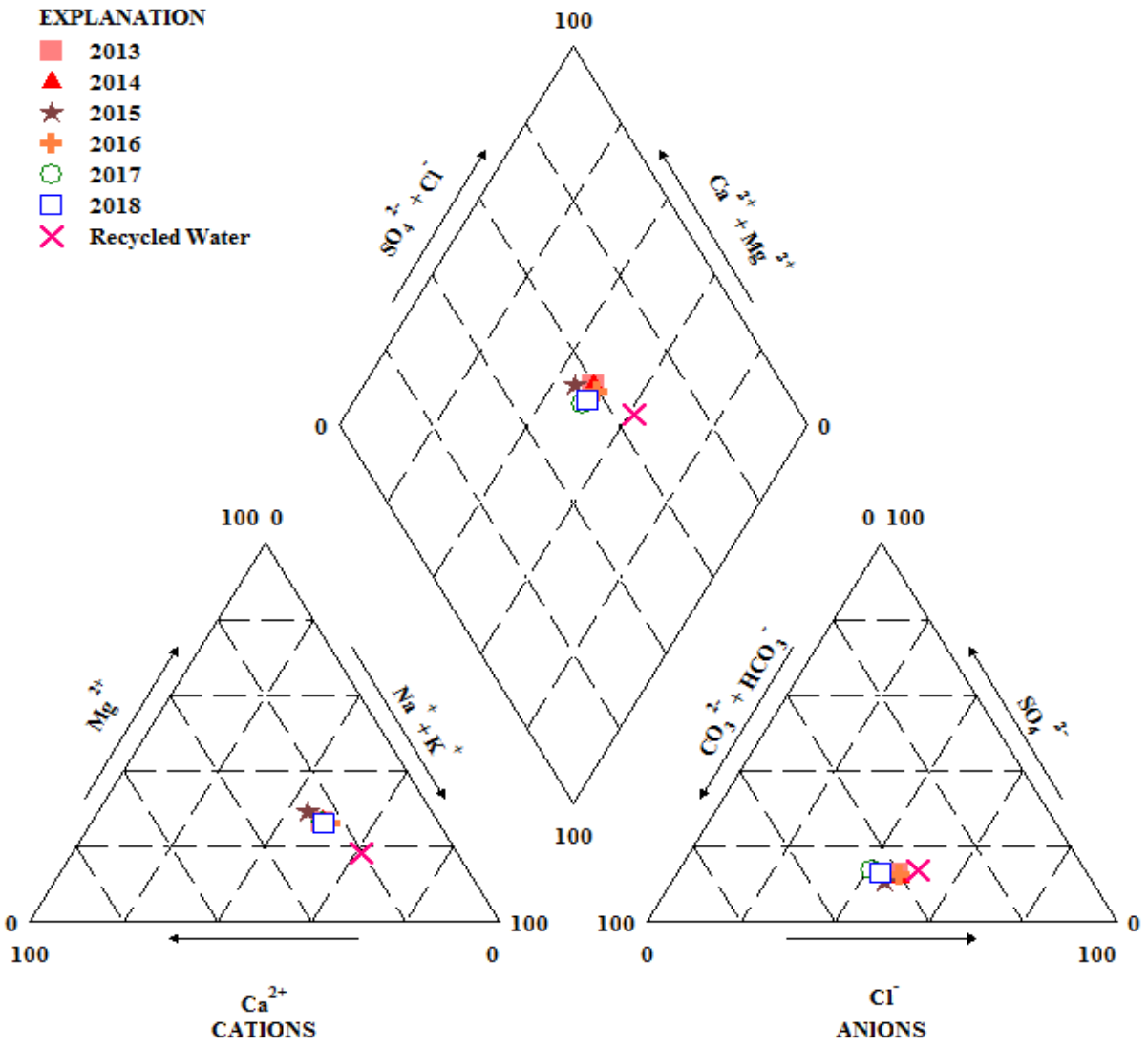


Figure E-5 Piper Diagram Monitoring Well at Christmas Hill Park, Llagas Subbasin



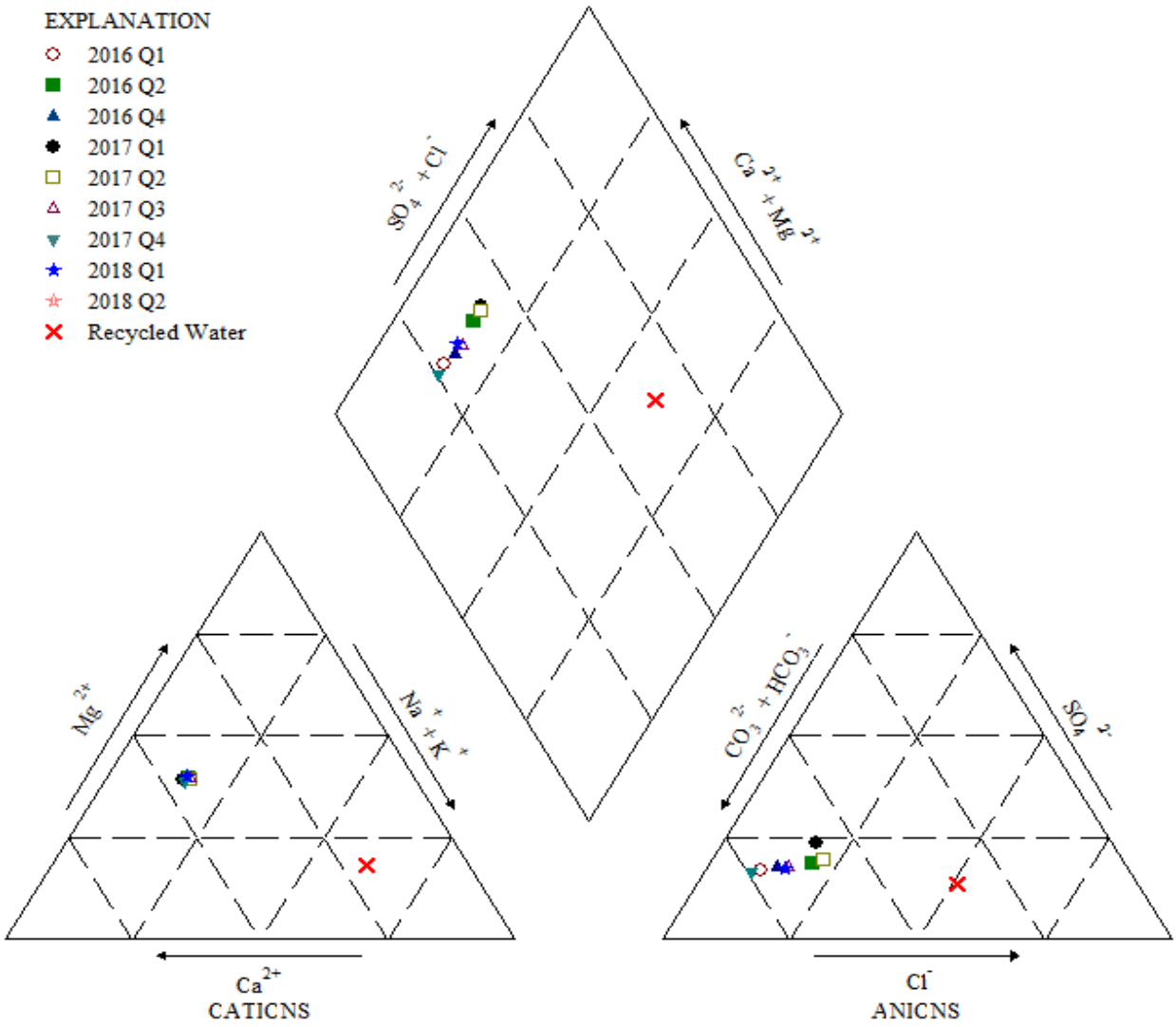
Piper diagram showing composition of recycled water and that of shallow groundwater during the period between 2003 and 2018. Note how plot locations of groundwater remain tightly grouped in all three diagrams (Cations, Anions, and center diamond) indicating minimal influence of recycled water irrigation on groundwater quality

Figure E-6 Piper Diagram Monitoring Well at SCRWA, Llagas Subbasin



Piper diagram showing composition of recycled water and that of shallow groundwater during the period between 2013 and 2018 of a shallow monitoring well at the SCRWA facility very near to a secondary waste-water disposal pond. Note how plot locations of groundwater plot very close to the recycled water end-member indicating that the quality of groundwater is like that of recycled water at this location

Figure E-7 Piper Diagram Monitoring Well at Third Street Park site (11S03E01E003), Llagas Subbasin



Piper diagram showing composition of recycled water and that of shallow groundwater during the period between 2016 and 2018 of a shallow monitoring at the 'Third Street Park' site, Gilroy. Note in triangle plot in lower right (Anions) how data have spread since 2016 toward the recycled water end-member (red X). Plot locations in the lower left triangle (Cations) remain more consistent over time. Note, 2016 Q3 sample not included in plot due to unverified data appearing out of expected norm.

Table E-3 Summary of 2018 Groundwater Data from Llagas Subbasin Recycled Water Irrigation Sites

Parameter	Units	Llagas Subbasin				Maximum Contaminant Level	
		n	Min	Median	Max	MCL	SMCL
Major and Minor Ions							
Bromate	ug/L	20	<0.25	<0.25	<0.25	10	--
Bromide	mg/L	20	<0.05	0.01	1.55	--	--
Calcium	mg/L	20	11.7	43.4	120	--	--
Calcium (as CaCO3)	mg/L	20	29.3	107.5	299	--	--
Chloride	mg/L	20	<5	27	190.5	--	250
Cyanide	mg/L	15	<0.025	<0.025	<0.025	150	--
Fluoride (natural source)	mg/L	20	<0.005	0.1	0.34	2	--
Magnesium	mg/L	20	4.6	23.5	80.6	--	--
Perchlorate	ug/L	15	<4	<4	<4	6	--
Potassium	mg/L	20	0.5	0.95	2.25	--	--
Silica	mg/L	20	12.5	25.3	35.8	--	--
Sodium	mg/L	20	4.9	24.4	146.5	--	--
Sulfate	mg/L	20	3.1	41	115	--	250
Total Dissolved Solids (TDS)	mg/L	19	66	281	762	--	500
Nutrients							
Nitrate (as N)	mg/L	20	<0.05	1.9	30.7	10	--
Orthophosphate (as P)	mg/L	20	<0.05	0.07	0.57	--	--
Trace Elements							
Aluminum	ug/L	20	<20	24.5	110	1,000	200
Antimony	ug/L	20	<1	<1	<1	6	--
Arsenic	ug/L	20	<2	<2	<2	10	--
Barium	ug/L	20	27	82.5	510	1,000	--
Beryllium	ug/L	20	<1	<1	<1	4	--
Boron	ug/L	20	<50	109	386	--	--
Cadmium	ug/L	20	<1	<1	<1	5	--
Chromium	ug/L	20	<1	<1	2.3	50	--
Cobalt	ug/L	20	<1	<1	3.55	--	--
Copper	ug/L	20	<1	1.2	8	1,300	1,000
Iron	ug/L	20	<20	<20	250	--	300
Lead	ug/L	20	<1	<1	<1	--	--
Lithium	ug/L	20	<5	5.9	12	--	--
Manganese	ug/L	20	<1	<1	1,385	--	50
Mercury	ug/L	15	<1	<1	<1	2	--
Molybdenum	ug/L	20	<1	<1	4.2	--	--
Nickel	ug/L	20	<1	1.8	21.3	100	--
Selenium	ug/L	20	<5	<5	<5	50	--
Silver	ug/L	20	<1	<1	<1	--	100
Thallium	ug/L	20	<1	<1	<1	2	--
Vanadium	ug/L	20	<1	1.2	5.45	--	--
Zinc	ug/L	20	<10	<10	<10	--	5000

Parameter	Units	Llagas Subbasin				Maximum Contaminant Level	
		n	Min	Median	Max	MCL	SMCL
Organic Compounds							
Bromochloroacetic Acid (BCAA)	ug/L	20	<1	<1	<1	1,000	200
Bromochloromethane	ug/L	20	<0.5	<0.5	<0.5	6	--
Bromodichloroacetic Acid	ug/L	20	<1	<1	<1	10	--
Bromodichloromethane (THM)	ug/L	20	<0.5	<0.5	<0.5	--	--
Bromoform (THM)	ug/L	20	<0.5	<0.5	<0.5	--	--
Bromomethane	ug/L	20	<0.5	<0.5	<0.5	--	--
Chlorodibromoacetic Acid	ug/L	20	<2	<2	<2	--	--
Chloroform (THM)	ug/L	20	<0.5	<0.5	<0.5	--	--
Dibromoacetic Acid (DBAA)	ug/L	20	<1	<1	<1	--	--
Dibromochloromethane (THM)	ug/L	20	<0.5	<0.5	<0.5	--	--
Dibromomethane	ug/L	20	<0.5	<0.5	<0.5	--	--
Dichloroacetic Acid (DCAA)	ug/L	20	<1	<1	<1	--	--
Haloacetic Acids (HAA5)	ug/L	20	<0.5	<0.5	<0.5	--	--
Monobromoacetic Acid (MBAA)	ug/L	20	<1	<1	<1	--	--
Monochloroacetic Acid (MCAA)	ug/L	20	<2	<2	<2	--	--
n-Nitrosodiethylamine (NDEA)	ng/L	20	<2	<2	<2	60	--
n-Nitrosodimethylamine (NDMA)	ng/L	17	<2	<2	2.8	--	--
n-Nitrosodi-n-Butylamine (NDBA)	ng/L	17	<2	0.3	4	--	--
n-Nitrosodi-n-Propylamine	ng/L	17	<2	<2	<2	--	--
n-Nitrosomethylethylamine	ng/L	17	<2	<2	<2	--	--
n-Nitrosopyrrolidine (NPYR)	ng/L	17	<2	<2	<2	--	--
Perfluoro Butanoic Acid (PFBA)	ng/L	20	<10	<10	16	--	--
Perfluoro Octanesulfonate (PFOS)	ng/L	20	<5	<5	89	--	--
Perfluoro Octanoic Acid (PFOA)	ng/L	20	<5	<5	50.5	--	--
Tribromoacetic Acid	ug/L	20	<4	<4	<4	--	--
Trichloroacetic Acid (TCAA)	ug/L	20	<1	<1	<1	--	--

Notes:

1. Table includes data for wells near areas irrigated with water from South County Water Regional Wastewater Authority (SCWRA).
2. n = the number of results for parameter
3. mg/L = milligrams per liter; ug/L = micrograms per liter; ng/L = nanograms per liter.
4. The minimum shown is the lowest detected value. The lowest reporting limit is shown (e.g., <5) when there are no quantified values at the lowest reporting limit.
5. For parameters with results less than multiple reporting limits, the median was computed using the Maximum Likelihood Estimate (MLE) method.
6. MCL = Maximum Contaminant Level as specified in Title 22 of the California Code of Regulations. The MCL is a health-based drinking water standard.
7. SMCL = Secondary Maximum Contaminant Level, or aesthetic-based standard per DDW or US EPA.

Table E-4 Trend Testing Summary - Llagas Subbasin

Well ID	Site	Aquifer Zone	Well Depth	Trend Period (yr)[2]	TRENDS[1]														
					TDS	Ca	Mg	Na	K	Cl	SO_4	NO_3	Br	HCO_3	NDMA	NDBA	PFOA	PFOS	PFBA
11S03E01E003	3rd St Park #4	Shallow	100	2.2	--[3]	--	--	--	--	--	--	--	--	--	--	--	--	--	--
11S03E01E004	3rd St Park #2	Shallow	43	2.2	--	--	--	--	--	--	--	--	down	--	--	--	--	--	--
11S03E01E005	3rd St Park #3	Shallow	43	2.2	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
11S03E02H004	3rd St Park #1	Shallow	43	2.2	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
11S03E01Q002	Christmas Hill Park #1	Shallow	44	15.3	--	--	--	--	--	up	--	--	--	--	--	--	--	--	--
11S03E12A002	Christmas Hill Park #2	Shallow	45	15.3	--	--	--	--	up	--	up	--	--	--	--	--	--	--	--
11S03E12A003	Christmas Hill Park #3	Shallow	45	15.3	--	--	--	--	up	--	--	--	--	--	--	--	--	--	--
11S04E07F004	Christmas Hill Park Uvas Cr.	Deep	200	3.8	down	up	up	up	up	--	--	--	--	down	--	--	--	--	--
11S04E09D002	McCarthy Ranch	Shallow	40	3.2	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
11S04E09M001	Obata Farm	Shallow	40	3.2	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
11S04E08C003	Princevalle Drain E	Shallow	45	3.8	--	--	--	--	--	--	--	--	--	--	--	--	down	--	down
11S04E15M002	SCRWA 22	Shallow	40	5.9	--	--	--	up	up	--	--	--	--	up	--	--	--	--	--
11S04E16F001	SCRWA 19	Shallow	45	5.9	--	--	--	--	up	--	--	--	--	--	--	--	--	--	--
11S04E16G003	SCRWA 24	Shallow	120	5.9	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
11S04E16M011	SCRWA Z	Shallow	45	4.8	down	--	--	--	up	down	--	--	--	--	--	--	--	--	--
11S04E07J005	Sports Park 1	Shallow	55.5	2.5	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
11S04E08M013	Sports Park 3	Shallow	54	2.5	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
11S04E08M015	Sports Park 4	Shallow	80	2.3	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
11S04E08N009	Sports Park 2	Shallow	60	2.5	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--

Notes:

1) Trend test used is Kendal's trend test, minimum number of samples needed is n = 4, test is conducted at 95% confidence using standard hypothesis test structure
2) Trend Period is the number of years of record for each station
3) The symbol "—" indicates no significant trend at 95% confidence using Kendal's trend test

Appendix F

Water Year 2018 Report for the Santa Clara and Llagas Subbasins (Submitted to the CA Department of Water Resources in March 2019)

March 2019

Water Year 2018 Report for the Santa Clara and Llagas Subbasins

Valley Water

Santa Clara Valley Water District

Water Year 2018 Report for the Santa Clara and Llagas Subbasins

Prepared by:

Bassam Kassab, P.E.
Senior Water Resources Specialist

Under the Direction of:

Vanessa De La Piedra, P.E.
Unit Manager
Groundwater Management Unit

Garth Hall, P.E.
Deputy Operating Officer
Water Supply Division

Nina Hawk
Chief Operating Officer
Water Utility Enterprise

Norma J. Camacho
Chief Executive Officer

March 2019

Valley Water
Clean Water • Healthy Environment • Flood Protection

Contributors:

Chanie Abuye

Ardy Ghoreishi

Graphic Design:

Benjamin Apolo III

Emily Cheung

BOARD OF DIRECTORS

Linda J. LeZotte
Chair, District 4

Nai Hsueh
Vice Chair, District 5

Barbara Keegan
District 2

Tony Estremera
District 6

John L. Varela
District 1

Richard P. Santos
District 3

Gary Kremen
District 7

TABLE OF CONTENTS

Page

EXECUTIVE SUMMARY ..... **ES-i**

CHAPTER 1 – INTRODUCTION **1**

CHAPTER 2 – GROUNDWATER ELEVATION DATA **3**

CHAPTER 3 – WATER SUPPLY AND USE **14**

3.1 Groundwater Extraction 14
3.2 Surface Water Supply Used 16
3.3 Total Water Use 17
3.4 Change in Groundwater Storage 18

CHAPTER 4 – PLAN IMPLEMENTATION **22**

2018 Annual Groundwater Report

EXECUTIVE SUMMARY

The Santa Clara Valley Water District (Valley Water) is the Groundwater Sustainability Agency for the Santa Clara and Llagas subbasins (Basins 2-9.02 and 3-3.01, respectively) in Santa Clara County, which are sustainably managed due to the comprehensive activities described in Valley Water's 2016 Groundwater Management Plan (Plan).[1] This Water Year 2018 Report for the Santa Clara and Llagas Subbasins provides information on groundwater conditions and management as required by the Sustainable Groundwater Management Act (SGMA).[2]

The subbasins fully recovered to pre-drought conditions in Water Year (WY) 2017, and groundwater elevation and storage remained sustainable in WY 2018.[3] In WY 2018, total groundwater pumping was about 122,200 acre-feet (AF), providing 41 percent of the water used by county residents and businesses. Despite below-average rainfall, adequate surface water supplies were available to support a full managed recharge program with 118,700 AF of local and imported surface water. Treated water delivered by Valley Water (105,500 AF) and recycled water use (17,800 AF) also provided in-lieu recharge, and countywide water conservation programs reduced water demands by about 76,000 AF. This comprehensive recharge continues to support a balanced long-term water budget. In WY 2018, inflows exceeded outflows in the Santa Clara Subbasin, resulting in a net increase in storage of about 26,100 AF. In the Llagas Subbasin, groundwater storage decreased by 1,100 AF during the same period.

Valley Water continues to implement the comprehensive activities described in the Plan, and to address the Plan recommendations (as further described in Chapter 4):

- Maintain existing conjunctive water management programs and evaluate opportunities for enhancement or increased efficiency.
- Continue to aggressively protect groundwater quality through Valley Water programs and collaboration with land use agencies, regulatory agencies, and basin stakeholders.
- Continue to incorporate groundwater sustainability planning in Valley Water planning efforts.
- Maintain adequate monitoring programs and modeling tools.
- Continue and enhance groundwater management partnerships with water retailers and land use agencies.
- Evaluate the potential new authorities provided by SGMA.

Valley Water will continue to sustainably manage the Santa Clara and Llagas subbasins as a central part of our mission to provide Silicon Valley safe, clean water for a healthy life, environment, and economy. Implementation of the Plan helps ensure continued sustainability in accordance with SGMA, the Santa Clara Valley Water District Act, and Valley Water Board policy to "aggressively protect groundwater from the threat of contamination and maintain and develop groundwater to optimize reliability and to minimize land subsidence and salt water intrusion."

[1] This Plan was submitted to the Department of Water Resources as an Alternative to a Groundwater Sustainability Plan. Per state requirements, an annual report must be submitted by April 1 of each year following Valley Water adoption of the Plan.
[2] Valley Water produces a comprehensive calendar-year based Annual Groundwater Report that provides detailed information on groundwater levels, storage, land subsidence and groundwater quality conditions. This report is available at: https://www.valleywater.org/groundwater.
[3] October 1, 2017 through September 30, 2018

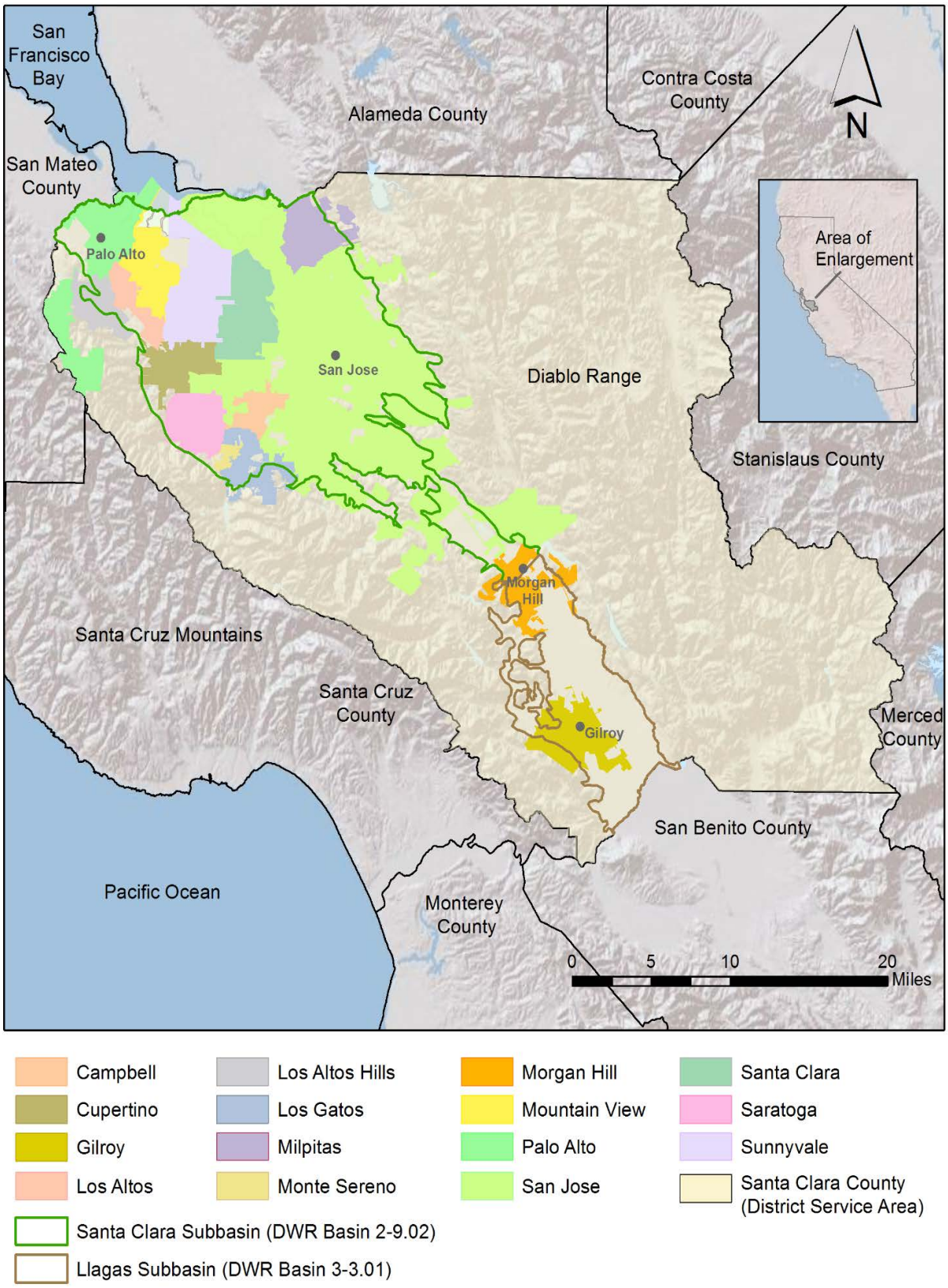
CHAPTER 1 – INTRODUCTION

For 90 years, Valley Water has managed groundwater in Santa Clara County under the Santa Clara Valley Water District Act.[4] In December 2016, Valley Water submitted its Board-adopted 2016 Groundwater Management Plan (Plan)[5] to the Department of Water Resources (DWR) as an Alternative to a Groundwater Sustainability Plan under SGMA. Valley Water's comprehensive groundwater management programs and investments described in the Plan have resulted in sustainable groundwater conditions for many decades, and will ensure groundwater resources are sustainable into the future.

Under the California Code of Regulations Title 23, Division 2, Chapter 1.5, Subchapter 2, Article 7, §356.2, each agency shall submit an annual report to DWR by April 1 of each year following adoption of the Plan. This report for Water Year (WY) 2018 is the second annual report submitted to DWR. It covers the Santa Clara Subbasin (DWR Basin 2-9.02) and the Llagas Subbasin (Basin 3-3.01), which are managed in their entirety by Valley Water. Figure 1 shows the location of the two groundwater subbasins.

The remainder of this page is intentionally left blank

Figure 1. Santa Clara and Llagas Subbasin Location Map



CHAPTER 2 – GROUNDWATER ELEVATION DATA

Valley Water tracks groundwater elevations, groundwater quality, and land subsidence through a countywide groundwater monitoring program. In WY 2018, Valley Water collected monthly groundwater elevation readings at 171 wells in the Santa Clara Subbasin and 58 wells in the Llagas Subbasin. Furthermore, local water retailers shared groundwater elevation data at 101 wells. While this report provides a summary of groundwater elevations based on 11 regional wells, all available countywide groundwater elevation data are accessible through the Valley Water website.[6] Valley Water also regularly uploads groundwater elevation data for Valley Water-owned wells to the California Statewide Groundwater Elevation Monitoring (CASGEM) program database.

Groundwater elevation contour maps for the Santa Clara and Llagas subbasins and related measurement locations are presented in Figures 2 and 3 for Spring 2018 and Fall 2018, respectively.[7] These contours represent the principal aquifer within each subbasin since those aquifers support the vast majority of pumping. Seasonal high groundwater conditions typically occur in March or April, with seasonal lows in September or October. The spring and fall maps were created using the water level readings measured closest to March 31, 2018 and September 30, 2018, respectively.

This report presents historical groundwater elevation data from 11 regional groundwater monitoring wells in the Santa Clara and Llagas subbasins (Figure 4); these monitoring wells are spatially distributed within the two subbasins and various cities in the county. Hydrographs for these wells show the static water level trend over the period of record, which varies by well (Figure 5).

Due to good water supply conditions, full managed recharge, and continued water use reduction by the community, groundwater elevations generally returned to pre-drought conditions in WY 2017. In fact, water levels in many wells approached or exceeded historical high levels. Groundwater levels remained sustainable in WY 2018 due to continued managed recharge and water use reduction, despite below-average precipitation. Groundwater elevations were far above the historical minima and levels seen during the last major droughts of 1987-1992 and 2012-2016, with strong artesian pressures observed in the northern Santa Clara Subbasin. Groundwater elevations were also well above Valley Water thresholds established to minimize the risk of land subsidence in the Santa Clara Subbasin.[8]

[6] https://gis.valleywater.org/GroundwaterElevations
[7] Groundwater elevations in this report use the North American Vertical Datum of 1988 (NAVD 88).
[8] As described in the Plan, land subsidence was a significant issue historically in the central and northern Santa Clara Subbasin. See Valley Water's Annual Groundwater Report for Calendar Year 2017 for a detailed discussion of recent subsidence monitoring: https://www.valleywater.org/groundwater. Note, the CY 2018 report will be available in summer 2019.

Figure 2. Spring 2018 Groundwater Elevation Contours

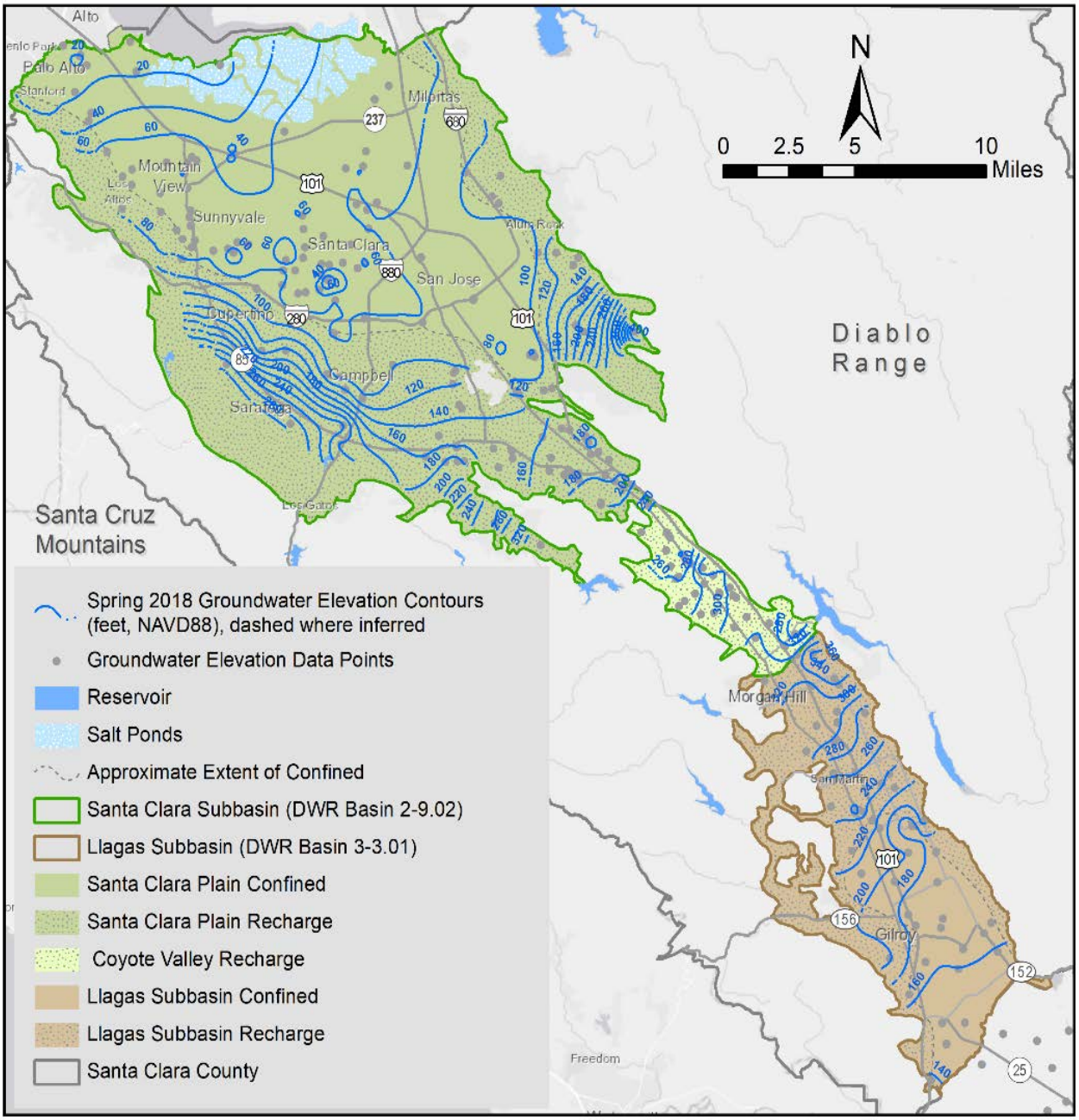


Figure 3. Fall 2018 Groundwater Elevation Contours

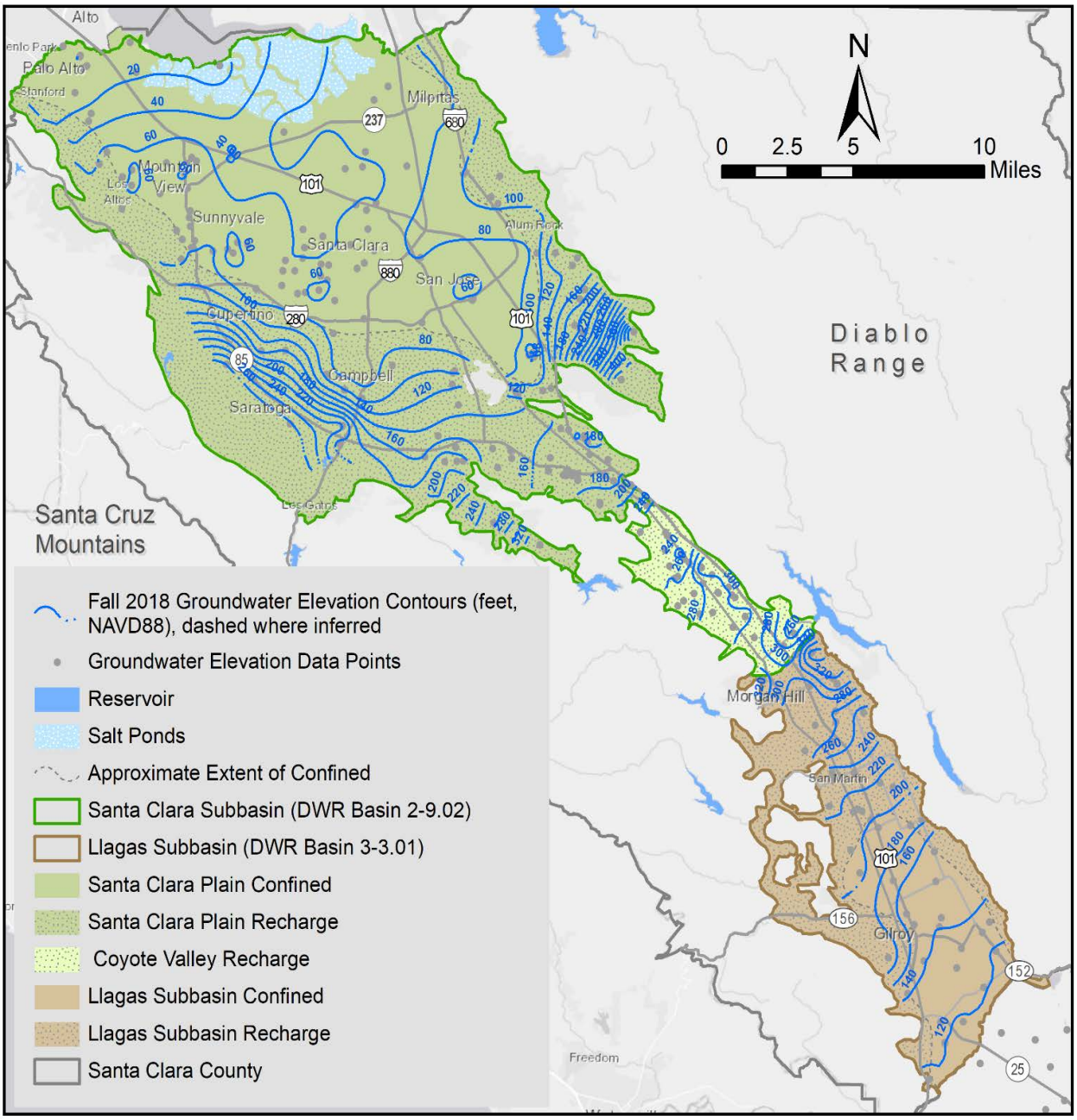


Figure 4. Regional Groundwater Elevation Monitoring Wells

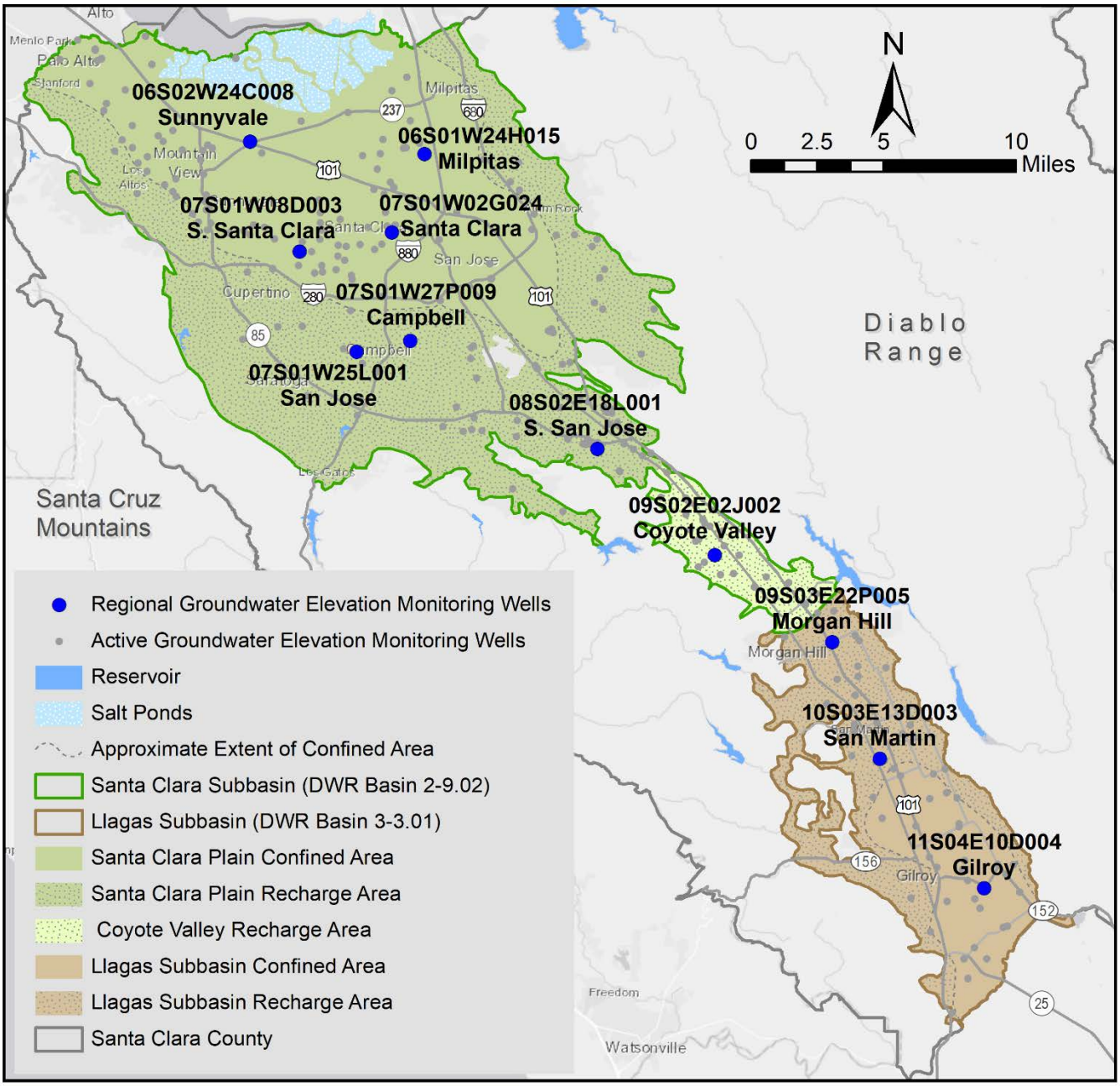
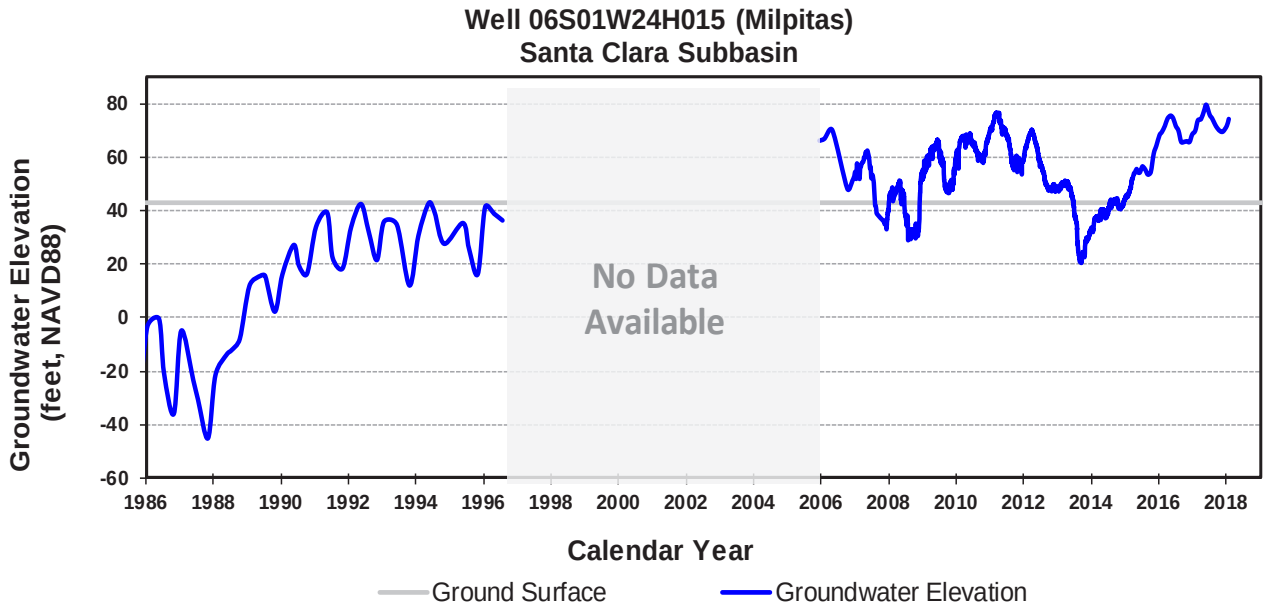
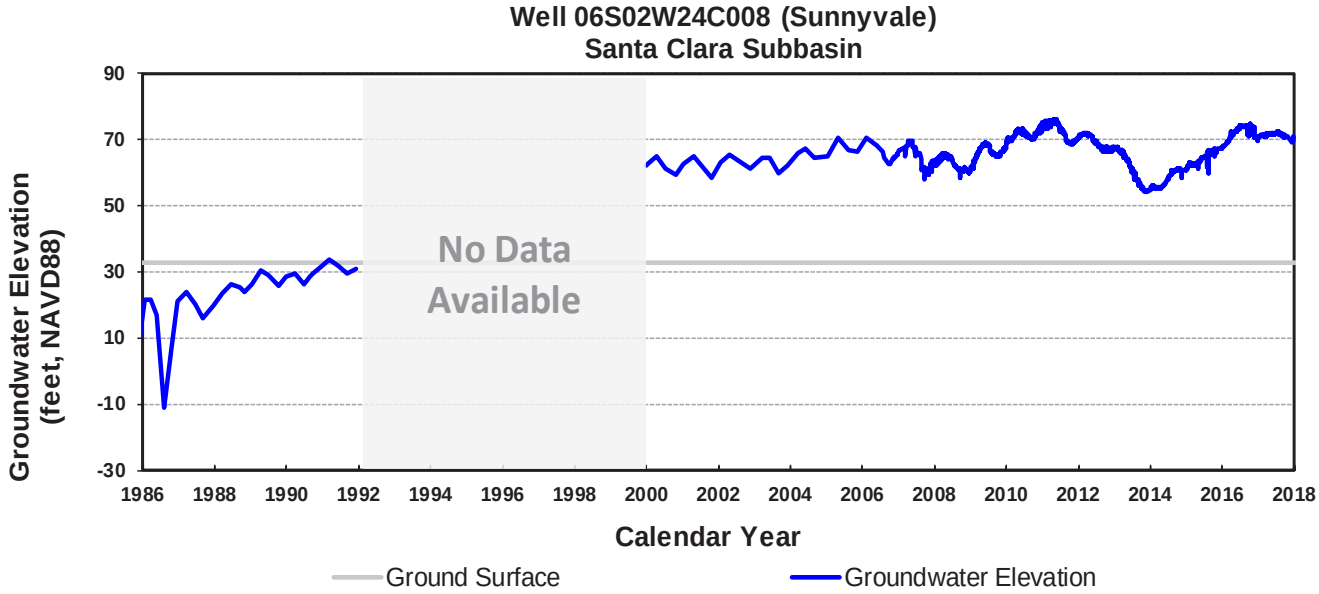


Figure 5. Hydrographs at Regional Groundwater Elevation Monitoring Wells

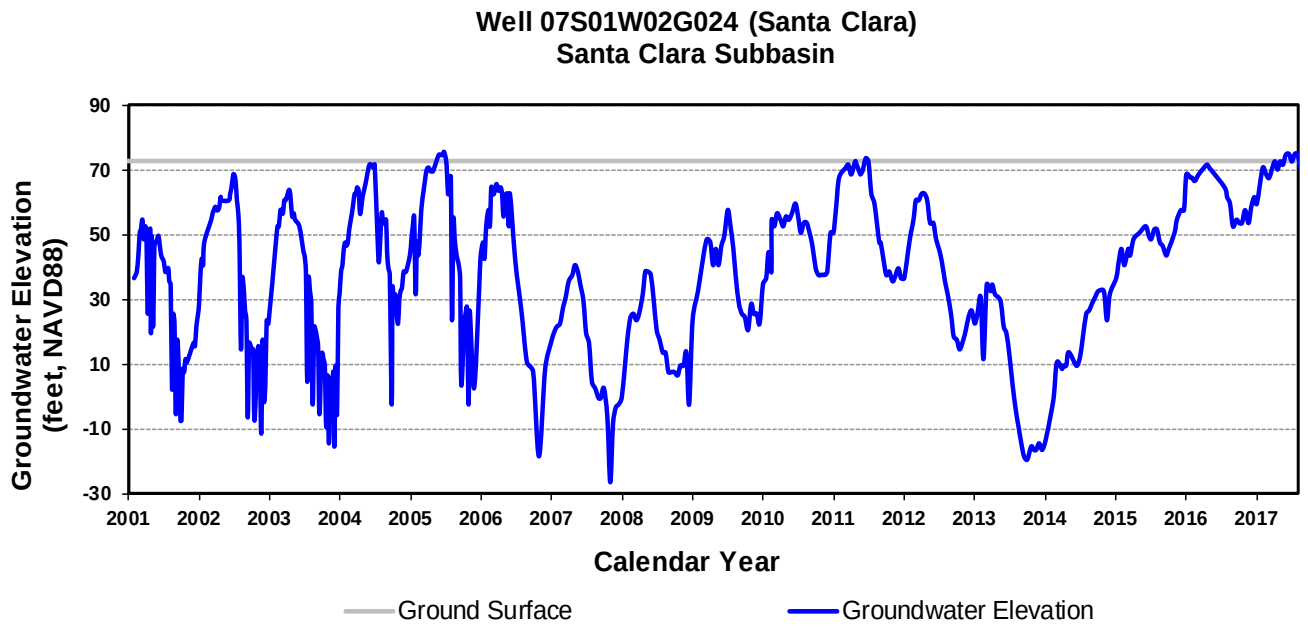


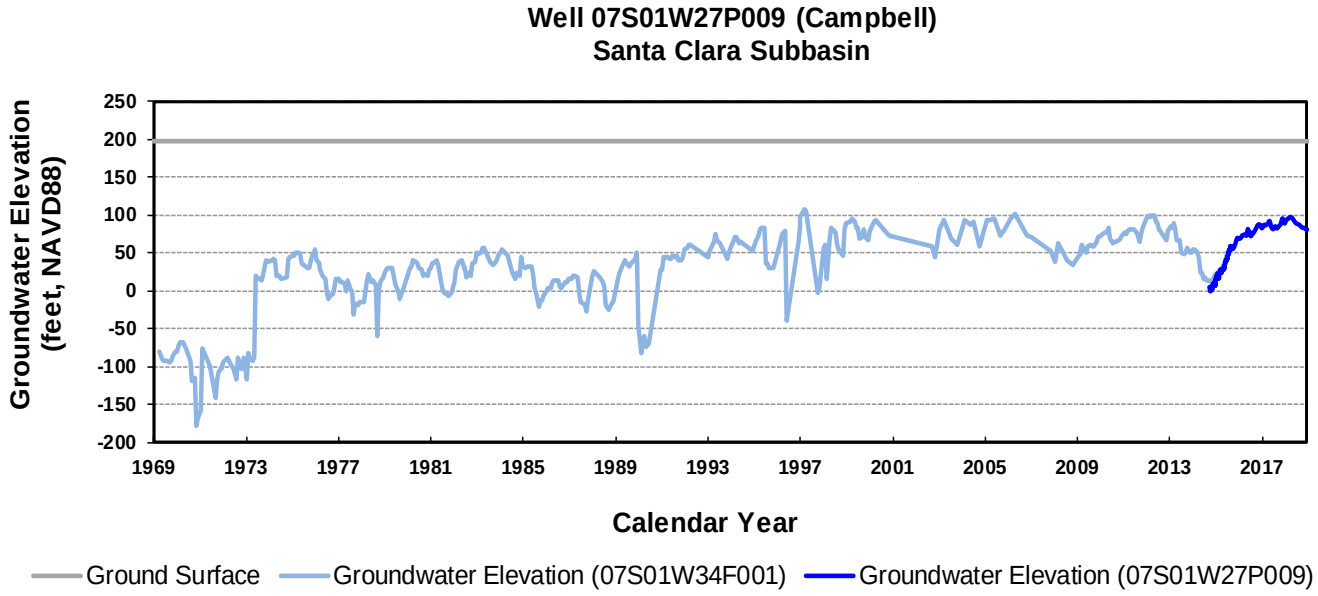
During period with no data available, well was observed to be artesian but there was no pressure gauge installed.



During period with no data available, well was observed to be artesian but there was no pressure gauge installed.

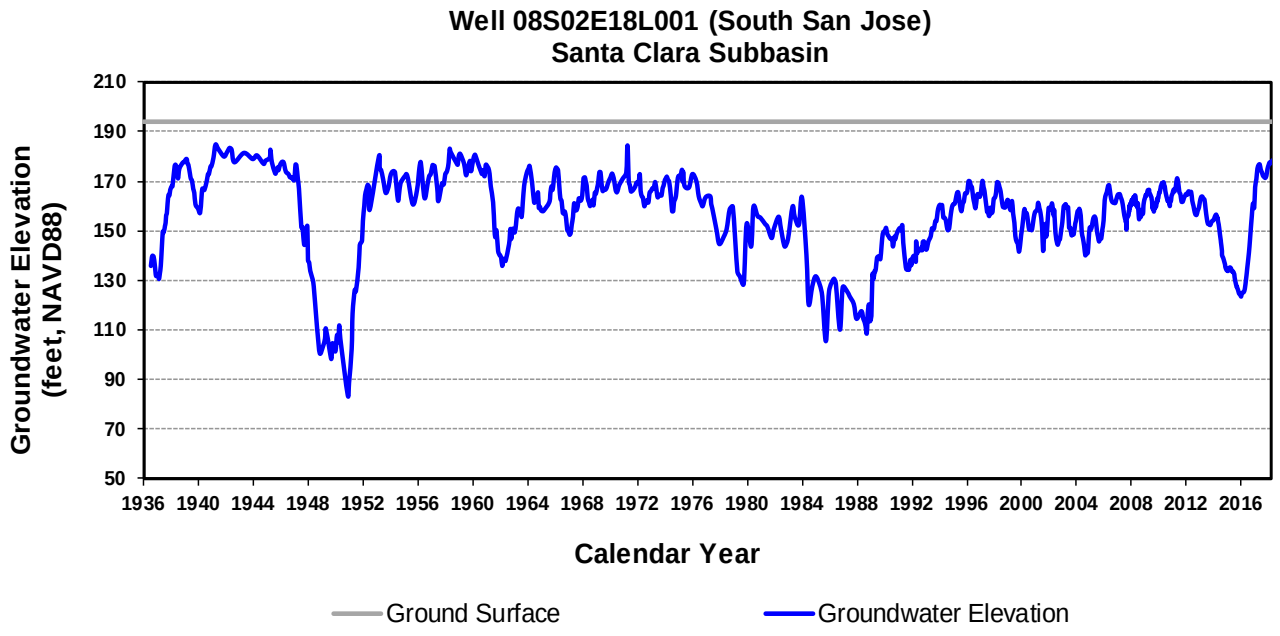
Figure 5. Hydrographs at Regional Groundwater Elevation Monitoring Wells (continued)





The Campbell well was replaced in August 2015 with a nearby well with similar water level history.

Figure 5. Hydrographs at Regional Groundwater Elevation Monitoring Wells (continued)



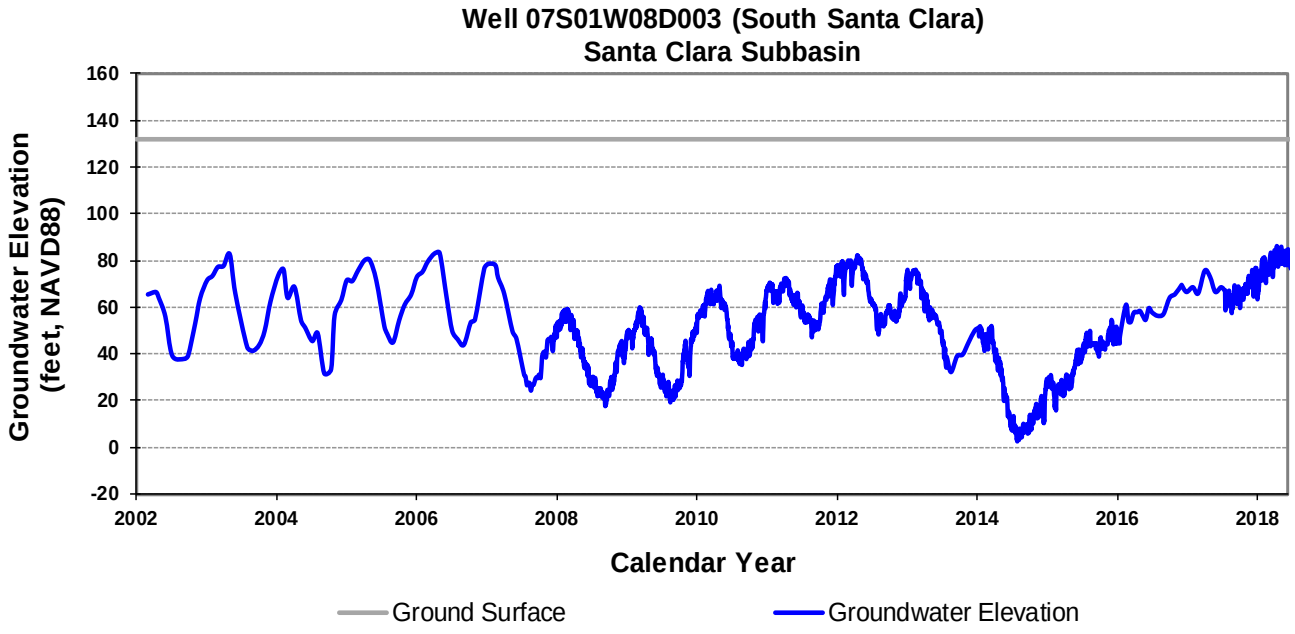
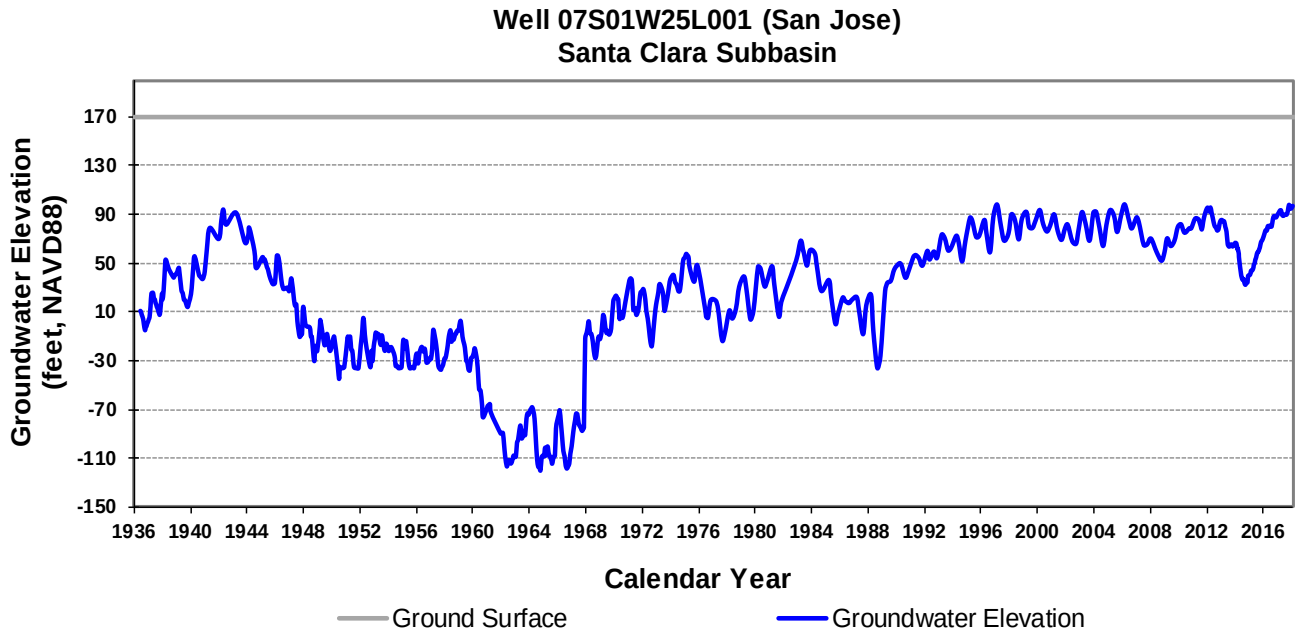


Figure 5. Hydrographs at Regional Groundwater Elevation Monitoring Wells (continued)



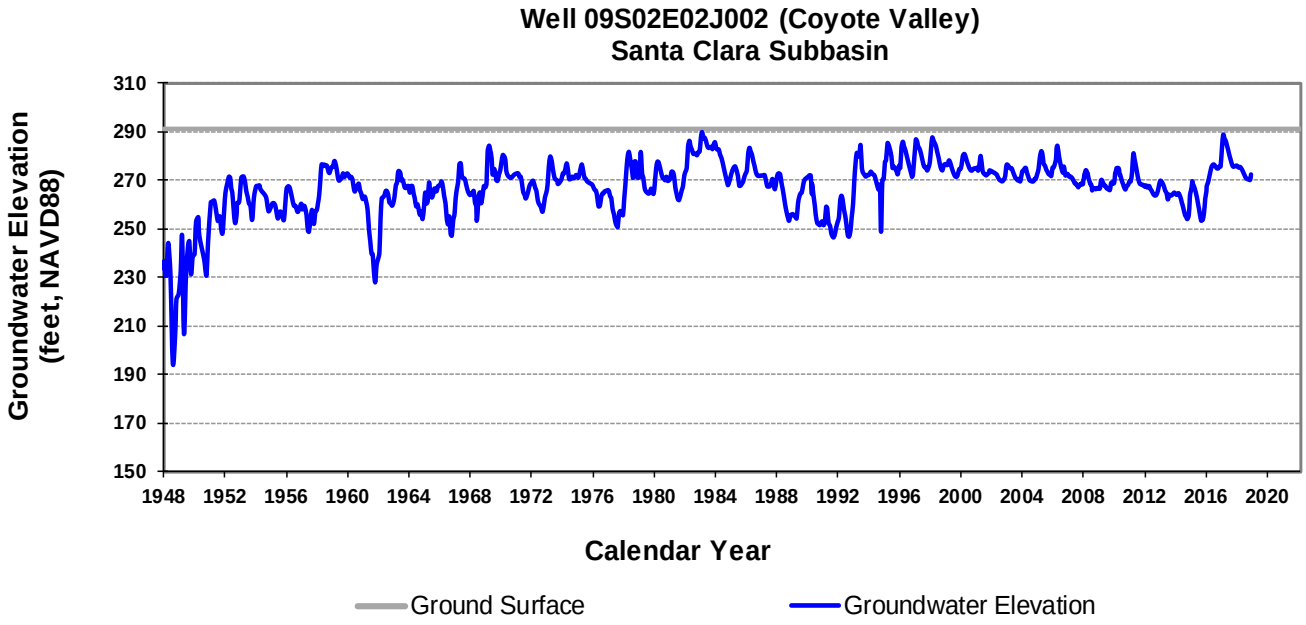
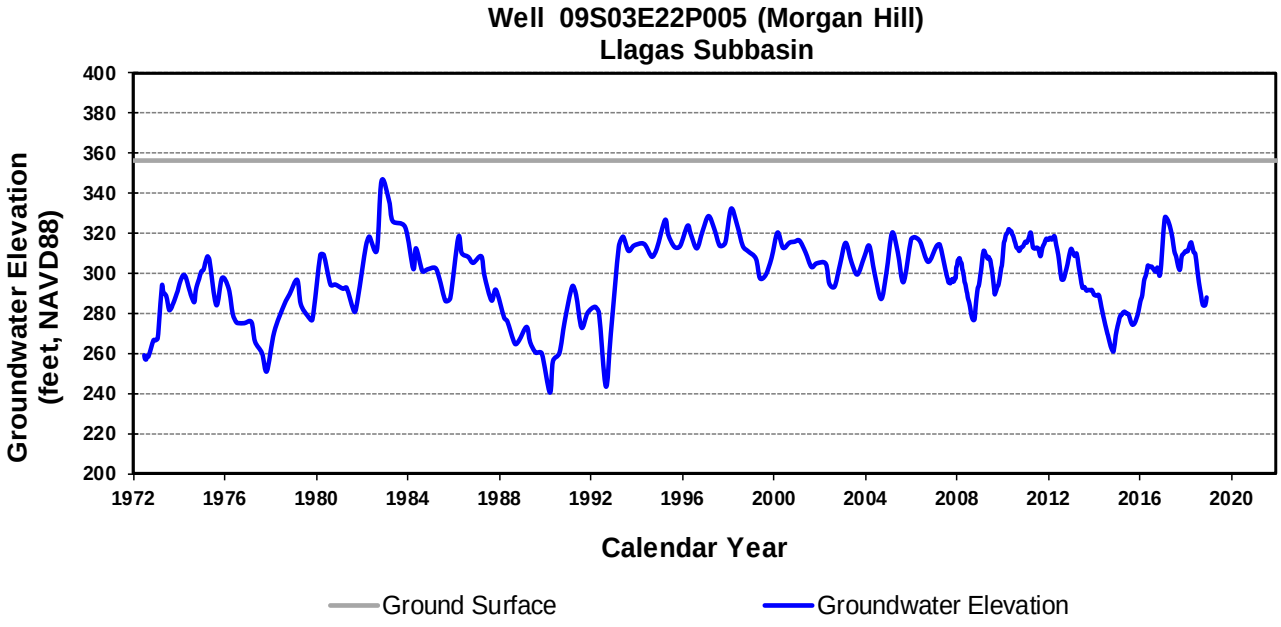


Figure 5. Hydrographs at Regional Groundwater Elevation Monitoring Wells (continued)



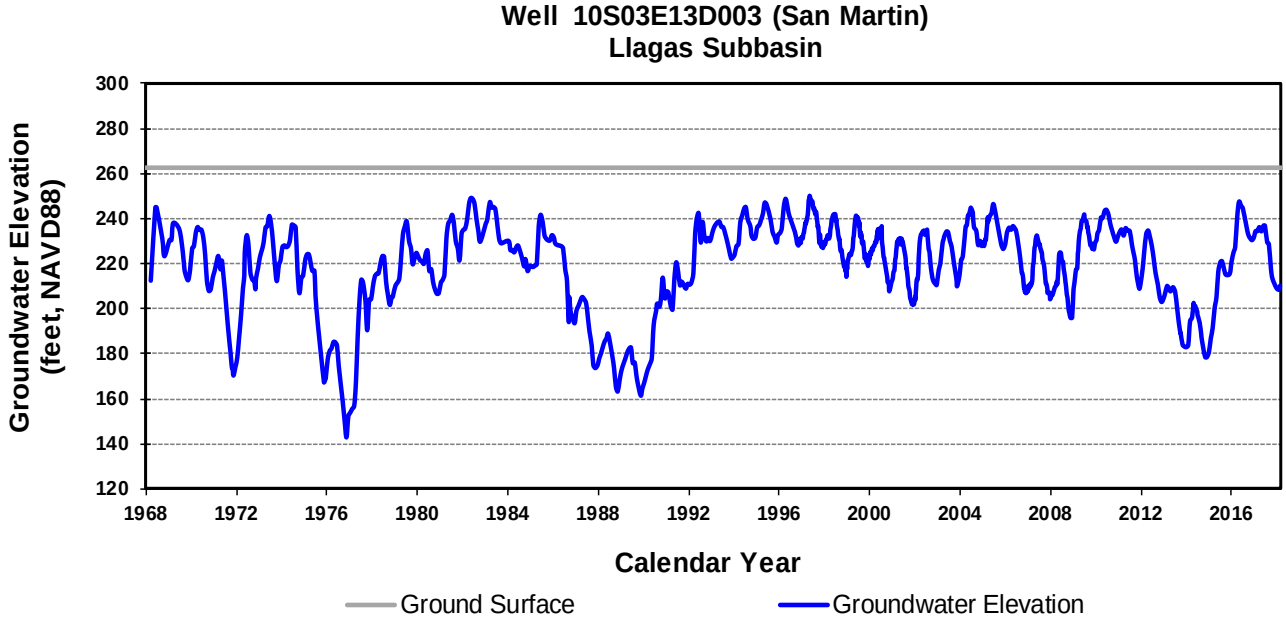
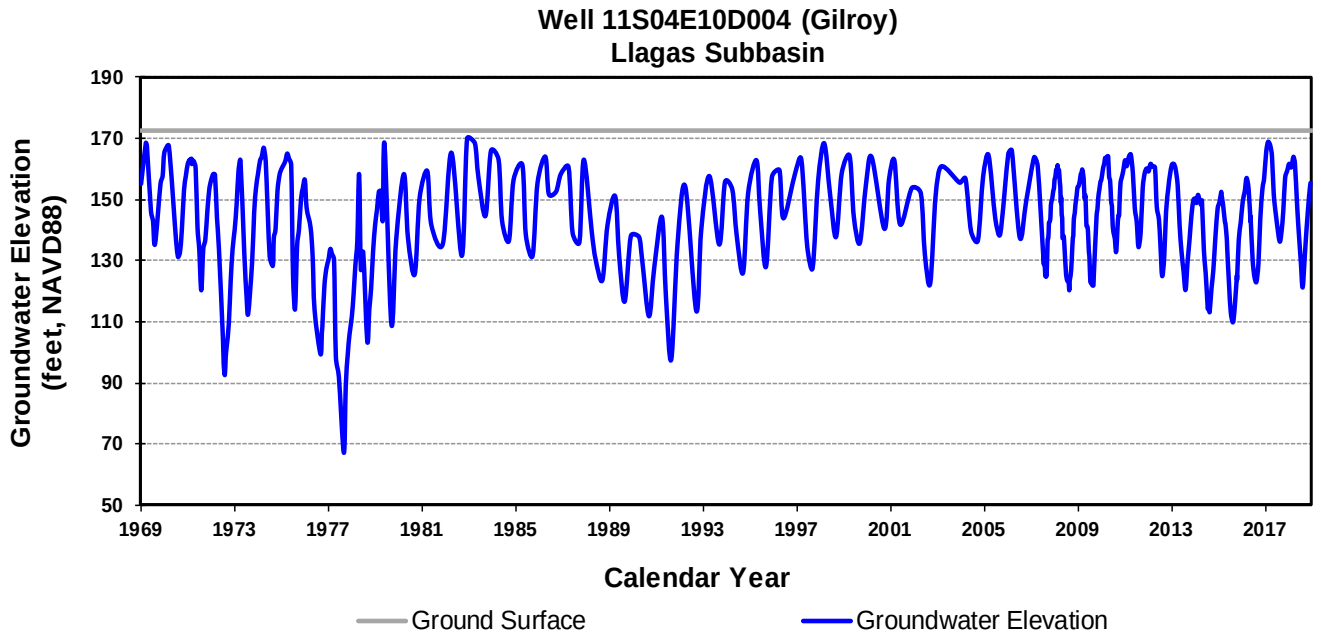


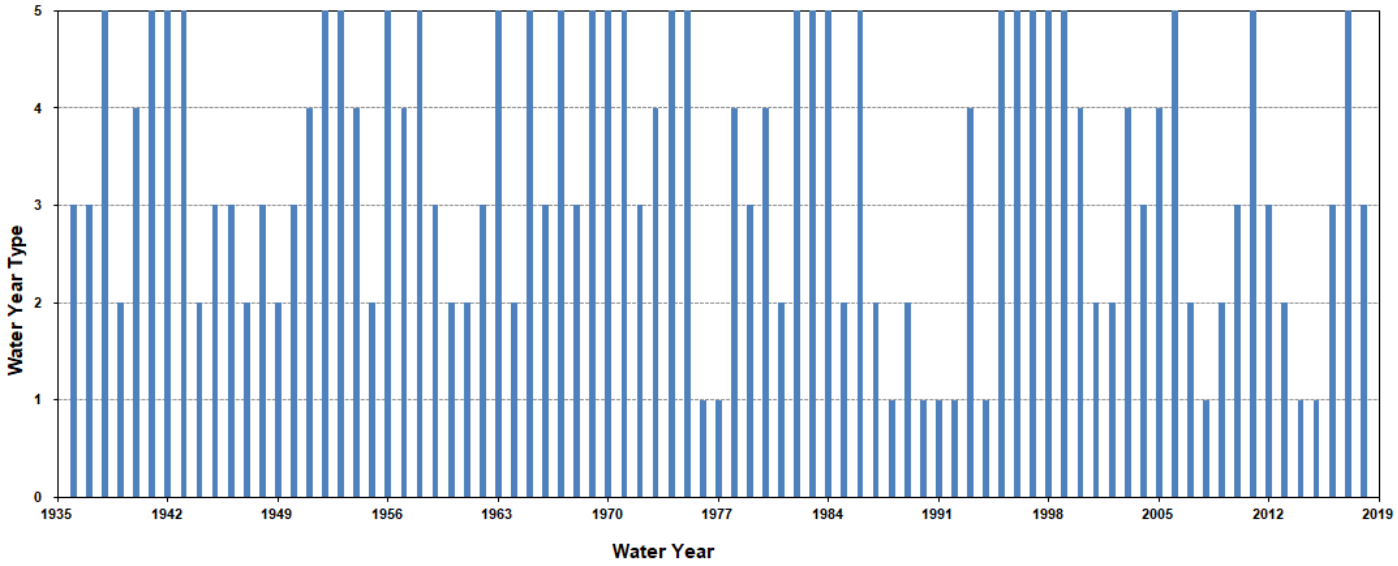
Figure 5. Hydrographs at Regional Groundwater Elevation Monitoring Wells (continued)



The remainder of this page is intentionally left blank

WY 2018 was a below-normal year per the DWR Sacramento River Index (SRI). Valley Water uses historical SRI water year types (Figure 6) to model hydrologic conditions in Santa Clara County as it reflects conditions in the Sierra and the Sacramento-San Joaquin Delta that influence Valley Water's imported water deliveries. Rainfall stations within Santa Clara County confirm that the rainfall season from July 1, 2017 to June 30, 2018 was below the historical average. For instance, rainfall in downtown San Jose (Station 131) was approximately 8.5 inches or 59 percent of average.

Figure 6. Water Year Types from WY 1936 to 2018 – Sacramento River Index (SRI)



Water Year Types per DWR SRI: 1 (Critical); 2 (Dry); 3 (Below Normal); 4 (Above Normal); 5 (Wet)

CHAPTER 3 – WATER SUPPLY AND USE

Valley Water manages a diverse water supply portfolio, with sources including groundwater, local surface water, imported water, and recycled water. About half of the county's water supply comes from local sources with the other half from imported sources. Imported water includes Valley Water's State Water Project (SWP) and Central Valley Project (CVP) contract supplies, and supplies delivered by the San Francisco Public Utilities Commission (SFPUC) to cities in northern Santa Clara County. Local sources include natural groundwater recharge and surface water supplies. A small but growing portion of the county's water supply is recycled water.

Valley Water distributes local and imported surface water supplies to managed recharge facilities, three drinking water treatment plants, local creeks for environmental needs, or directly to water users. The conjunctive management of surface water and groundwater maximizes water supply reliability, allowing Valley Water to store surface water in local groundwater basins to help balance pumping and provide reserves for use during dry years.

3.1 Groundwater Extraction

Total groundwater pumping in WY 2018 was about 122,200 acre-feet (AF), providing 41 percent of the water used by county residents and businesses. Figure 7 shows the location and volume of groundwater pumping, and Table 1 summarizes WY 2018 pumping by subbasin, water use category, and measurement method and accuracy.

About 79,600 AF of groundwater was pumped in the Santa Clara Subbasin, with 95% of that supporting municipal and industrial (M&I) uses. Agricultural and domestic use totaling about 4,200 AF was generally limited to the more rural Coyote Valley in the southern part of the subbasin. Total pumping in the Llagas Subbasin was about 42,600 AF. In this subbasin, agricultural use was more significant (23,500 AF), accounting for about 55% of the total pumping. M&I groundwater use was about 17,300 AF, or 41% of subbasin pumping. While the quantity of groundwater used for domestic purposes was relatively small in the Llagas Subbasin (about 1,800 AF, or 4%), nearly 2,600 individual domestic wells reported groundwater use in WY 2018.

Groundwater pumped from the subbasins is recorded in accordance with the Santa Clara Valley Water District Act. This act requires owners to register all wells within the county, and that water-producing wells within Valley Water's groundwater benefit zones file monthly, semi-annual, or annual production statements depending on the amount of water produced. By Valley Water Board Resolution, meters are only installed at those sites determined to be economically feasible per approved criteria or as required to facilitate the complete and accurate collection of groundwater production revenue. In the northern Zone W-2, which essentially overlaps the Santa Clara Plain, meters are required for facilities producing more than 4 AF of agricultural water or more than 1 AF of non-agricultural water annually. Within Zone W-5 (essentially coincident with the Coyote Valley and Llagas Subbasin), meters are required for facilities producing more than 20 AF of agricultural water or more than 2 AF of non-agricultural water.

Metered wells extracted the vast majority (91%) of the groundwater pumped in WY 2018. Where meters were not used, crop factors were used to determine agricultural water use, whereas domestic use was estimated from a table of average uses.

Figure 7. WY 2018 Groundwater Pumping in the Santa Clara and Llagas Subbasins

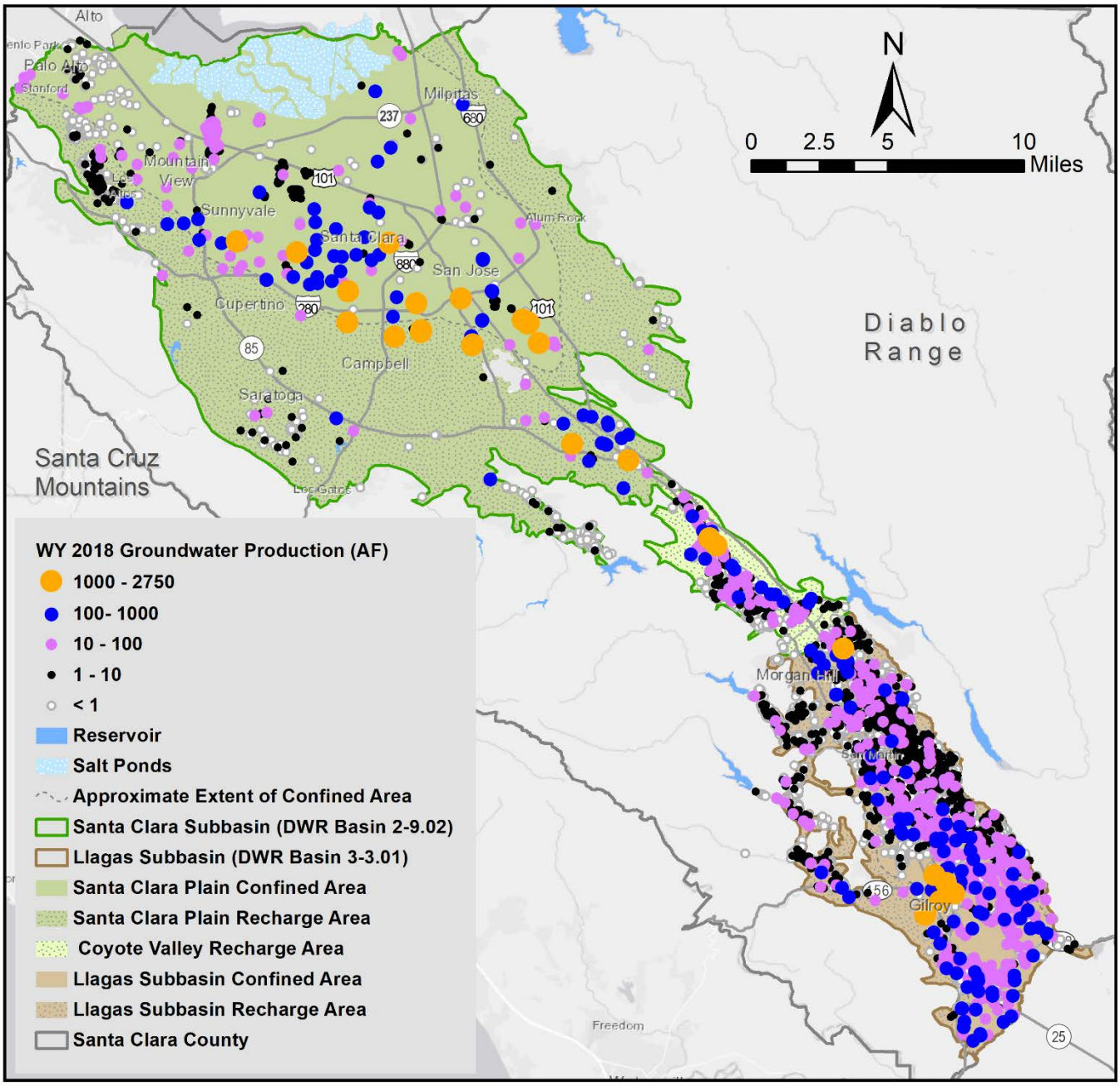


Table 1. WY 2018 Groundwater Pumping (AF) by Water Use

Water Use Sector	Measurement Method	Santa Clara Subbasin	Llagas Subbasin	Total Pumping	Accuracy
M&I	Metered	73,800	16,500	90,300	Within 2%
	Estimated	1,600	800	2,400	N/A
Domestic	Metered	100	100	200	Within 2%
	Estimated	400	1,700	2,100	N/A
Agricultural	Metered	2,900	17,300	20,200	Within 2%
	Estimated	800	6,200	7,000	N/A
Total		**79,600**	**42,600**	**122,200**	

Notes:

- As shown above, the majority of groundwater pumping is metered. Smaller pumpers are required to report production semi-annually or annually on a fiscal year (July 1 – June 30) basis. Non-metered pumpers report groundwater pumping based on crop factors (agricultural use) or table of average uses (domestic use). In this table, estimated pumping shown for the water year is based on fiscal year reporting and typical pumping patterns.
- All values are rounded to the nearest hundred.

3.2 Surface Water Supply Used

In WY 2018, Valley Water actively recharged about 118,700 AF of imported and local surface water in the Santa Clara and Llagas subbasins. Valley Water also provided about 107,600 AF of in-lieu recharge in the form of treated surface water deliveries to retailers (cities and water companies) and raw surface water deliveries to customers. This is in addition to SFPUC deliveries to eight retailers overlying the Santa Clara Subbasin and recycled water deliveries by Valley Water and four recycled water producers in the county, which totaled 64,200 AF countywide. Valley Water's long-term water conservation programs also saved about 76,000 AF, which further reduced the demand on groundwater.

Valley Water Managed Recharge

Valley Water replenishes the groundwater subbasins with imported water and watershed runoff captured in 10 local reservoirs. Valley Water's recharge facilities include more than 300 acres of recharge ponds and over 90 miles of creeks. Imported sources include the SWP and the federal CVP. The volumes of imported or local water used for managed recharge each year depend on many factors including hydrology, imported water allocations, treatment plants demands, and environmental needs. In general, a greater percentage of local water is used for recharge in wet years due to increased capture of storm runoff in local reservoirs. In WY 2018, Valley Water recharged about 98,400 AF of local and imported water in the Santa Clara Subbasin and about 20,300 AF in the Llagas Subbasin.

In-Lieu Use of Surface Water Supplies

Valley Water's treated and raw surface water deliveries, SFPUC supplies to local retailers, and recycled water programs play a critical role in maintaining groundwater elevations and storage by reducing demands on groundwater. Table 2 summarizes the supplies from these categories in areas that were historically primarily or solely served by groundwater.

3.3 Total Water Use

Total water use in Santa Clara County in WY 2018 is summarized in Table 2, which includes water use categories, measurement methods and accuracy, water sources, and use sectors. While the county boundary extends beyond the subbasins, the vast majority of the population and associated water use coincides with the subbasins.

Table 2. Santa Clara County Total Water Use in AF for WY 2018

Water Use[1]	Santa Clara Subbasin	Llagas Subbasin	County-wide	Measurement Method	Accuracy	Source	Sector
Groundwater Pumped	79,600	42,600	122,200	Metered (91%) and estimated[2]	Within 2 percent (metered)	Natural recharge, managed recharge of local runoff and imported (SWP/CVP) water	M&I, domestic and agricultural[3]
Valley Water Treated Water	105,500	0	105,500	Metered	Within 2 percent	Local runoff and imported (SWP/CVP) water	M&I
Valley Water Raw Surface Water Deliveries	800	1,300	2,100	Metered (95%) and estimated[2]	Within 2 percent (metered)	Local runoff and imported (SWP/CVP) water	M&I, domestic and agricultural
SFPUC Supplies to Local Retailers[4]	46,400	0	46,400	Metered	Within 1.5 percent	Surface water reservoirs[5]	M&I
Recycled Water	15,600	2,200	17,800	Metered	Variable[6]	Treated wastewater	M&I and agricultural
Total[7]	**247,900**	**46,100**	**294,000**				

[1] All water use values are rounded to the nearest hundred.
[2] Production from some smaller wells and raw surface water users is estimated using a table of average uses or crop factors.
[3] Groundwater use by sector is shown in Table 1.
[4] San Francisco Public Utilities Commission (SFPUC) supplies water to eight (8) retailers in Santa Clara County and NASA-AMES.
[5] SFPUC primary sources are surface water reservoirs with runoff mainly from the Hetch Hetchy watershed and also from the Alameda and Peninsula watersheds. More information is available at: https://sfwater.org/index.aspx?page=355.
[6] Recycled water meter accuracy varies as each of the four producers within the county uses different methods to measure production and delivery of recycled water.
[7] Local water rights used by the San Jose Water Company (SJWC) and Stanford within the Santa Clara Subbasin are not reflected in the total. In WY 2018, SJWC local water rights amounted to 6,400 AF. Stanford has historically used between 200 and 1,000 AFY.

3.4 Change in Groundwater Storage

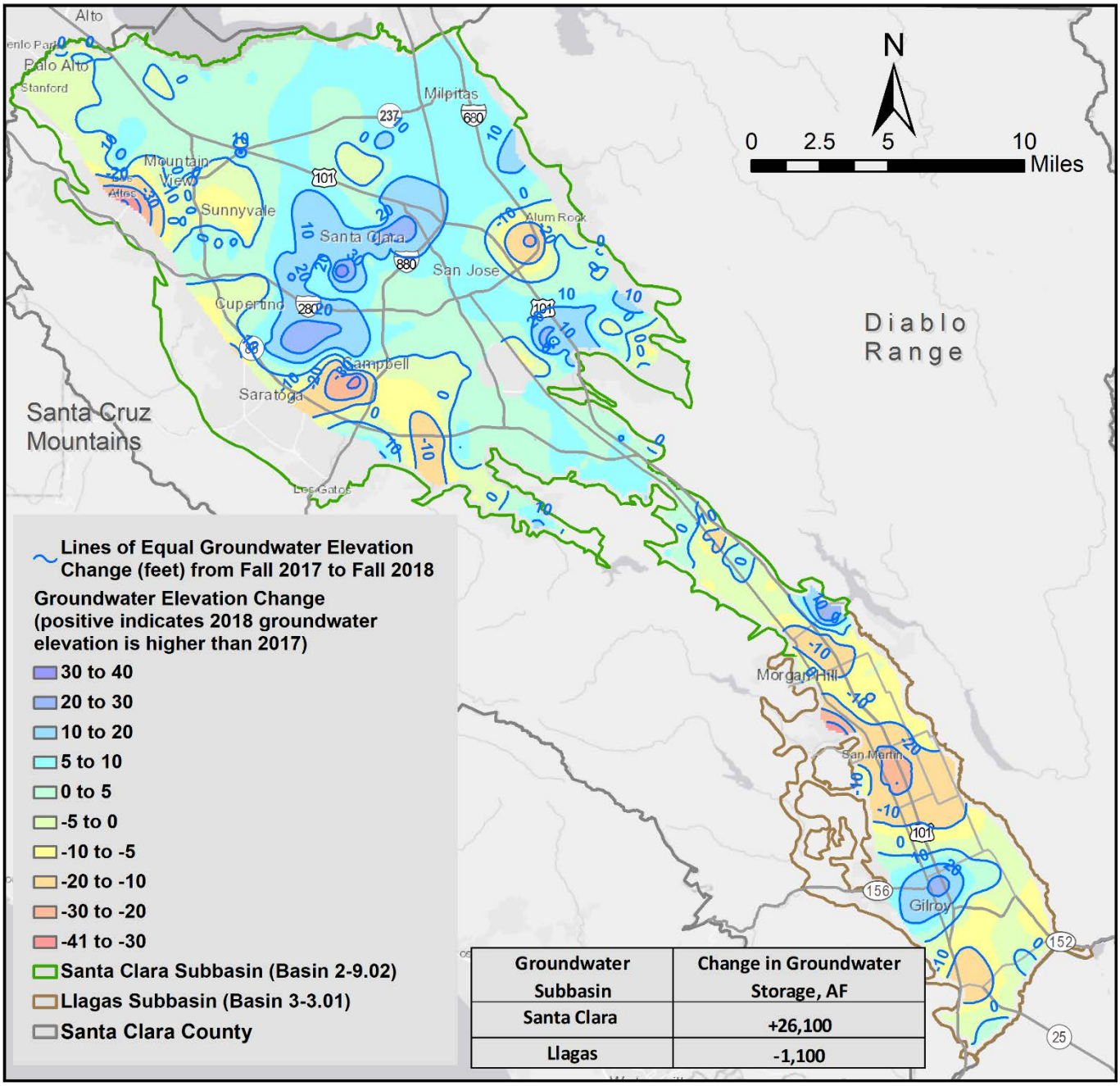
Due to good water supply conditions, robust managed recharge, and continued lower groundwater use since the drought, Valley Water estimates a net increase in countywide groundwater storage of about 25,000 AF in WY 2018 compared to WY 2017. Storage increased by about 26,100 AF in the Santa Clara Subbasin and decreased by about 1,100 AF in the Llagas Subbasin. Groundwater storage is the primary trigger for action under Valley Water's Water Shortage Contingency Plan, and storage remained well in the "Normal" stage (e.g., no shortage response required) in WY 2018.

Figure 8 depicts the change in groundwater elevation from October 2017 to September 2018 at more than 200 principal aquifer water level wells in the Santa Clara Subbasin and more than 45 wells in the Llagas Subbasin, respectively. The corresponding change in storage, as estimated from Valley Water's calibrated groundwater flow models, is also shown.

Figures 9 and 10 present the water year type, groundwater use, annual change in groundwater storage, and cumulative change in groundwater storage for the Santa Clara and Llagas subbasins, respectively, from WY 1991 through WY 2018. These figures show that over this period, the annual change within each basin has most frequently been an increase in groundwater storage. The most notable exceptions, also evident in hydrographs, occur during droughts, as expected. However, Valley Water programs to recharge and manage groundwater support fairly rapid recovery of water levels and storage, helping ensure long-term sustainability. As mentioned previously, groundwater levels and storage in the Santa Clara and Llagas Subbasins recovered from the 2012-2016 drought, with groundwater elevations far above historical minima and drought levels, and strong artesian pressures observed in the northern Santa Clara Subbasin.

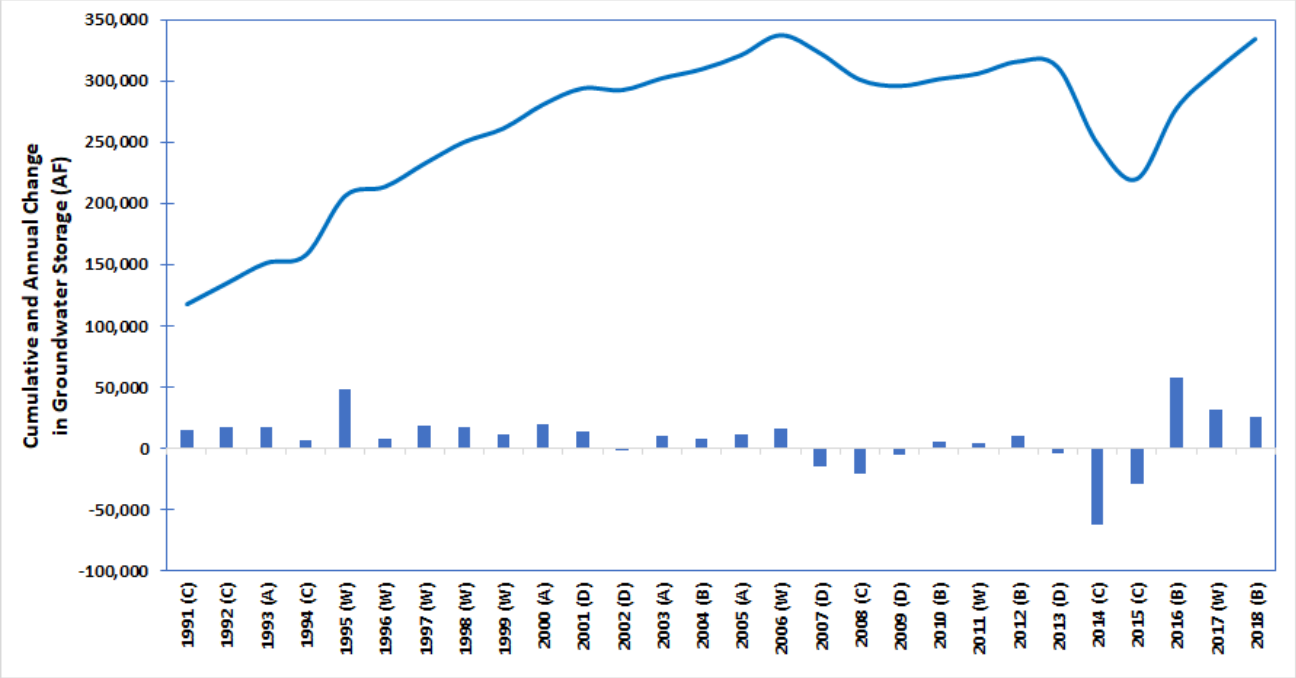
The remainder of this page is intentionally left blank

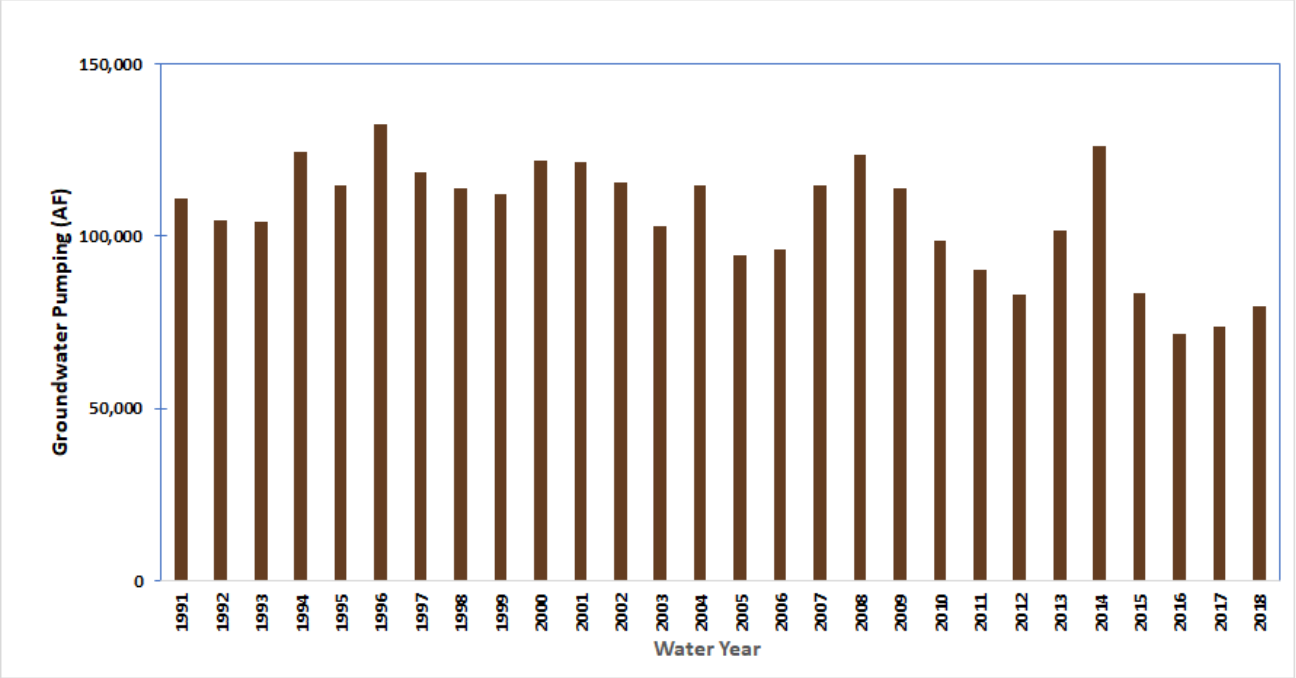
Figure 8. Change in Groundwater Elevation and Storage from October 2017 to September 2018



Groundwater Subbasin	Change in Groundwater Storage, AF
Santa Clara	+26,100
Llagas	-1,100

Figure 9. Groundwater Use and Change in Storage in the Santa Clara Subbasin

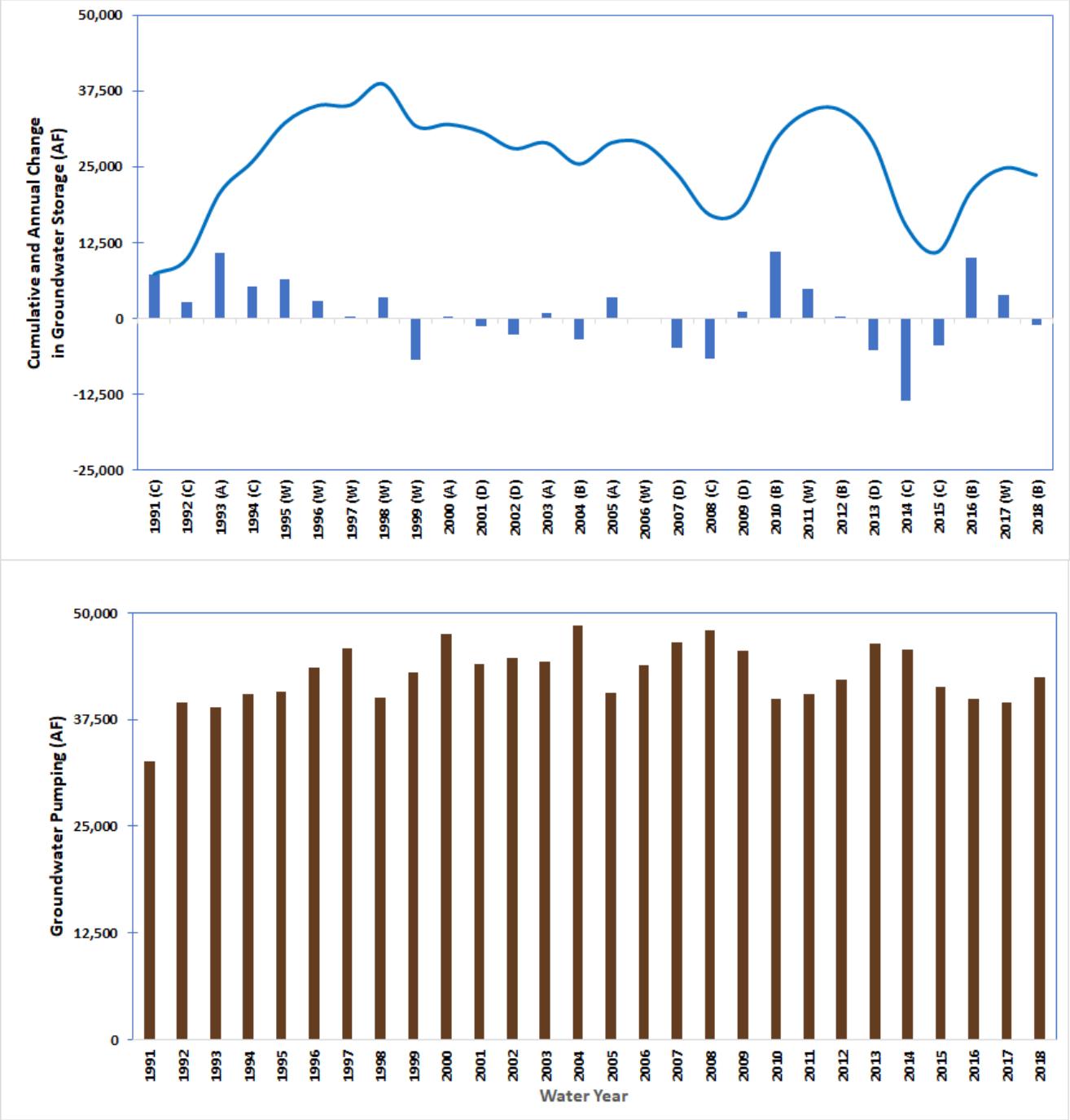




Notes:

- DWR SRI water year types are: Critical (C), Dry (D), Below Normal (B), Above Normal (A), and Wet (W).
- The storage graph begins in 1991 because Valley Water estimates Santa Clara Subbasin storage using two numerical models. The Santa Clara Plain model for the northern Santa Clara Valley begins in 1970 while the Coyote Valley model for the southern part of the subbasin begins in 1991 as Valley Water did not begin managing that area until the late 1980s.
- Most groundwater pumping is reported monthly and is reported here by water year. However, pumpers that report semi-annually or annually provide data based on the fiscal year (July 1 to June 30). For these reporters, groundwater pumping shown in this figure represents the fiscal year, which is presumed to be similar to the water year.

Figure 10. Groundwater Use and Change in Storage in the Llagas Subbasin



Notes:

- DWR SRI water year types are: Critical (C), Dry (D), Below Normal (B), Above Normal (A), and Wet (W).
- The storage graph begins in 1991 because Valley Water estimates Llagas Subbasin storage using a numerical model that begins in 1991 as Valley Water did not begin managing that area until the late 1980s.
- Most groundwater pumping is reported monthly and is reported here by water year. However, pumpers that report semi-annually or annually provide data based on the fiscal year (July 1 to June 30). For these reporters, groundwater pumping shown in this figure represents the fiscal year, which is presumed to be similar to the water year.

CHAPTER 4 – PLAN IMPLEMENTATION

Valley Water continues to implement the comprehensive conjunctive management, groundwater monitoring, and groundwater protection programs described in the Plan. As a result, conditions in the Santa Clara and Llagas subbasins remained sustainable. In fact, groundwater levels and storage in the two subbasins have recovered to pre-drought conditions due to proactive drought response, improved water supplies, and significant recharge.

The Plan presents six major recommendations to maintain the long-term viability of groundwater resources. A summary of the status of each recommendation is below.

1. **Maintain existing conjunctive water management programs and evaluate opportunities for enhancement or increased efficiency.**

   This Plan recommendation has several sub-recommendations, including items related to infrastructure reliability, high-priority capital project implementation, and securing imported water sources, among others. Valley Water continues to focus on extensive groundwater recharge through direct replenishment and in-lieu recharge. Updates relative to this Plan recommendation are presented below.

   Capital Projects Supporting Conjunctive Management
   Valley Water's Fiscal Year 2019-23 Five-Year Capital Improvement Program (CIP) was adopted by the Board on May 8, 2018.[9] With a significant portion of Valley Water's water supply infrastructure approaching fifty to sixty years of age, maintaining and upgrading the existing infrastructure to ensure each facility functions as intended for its useful life became the focus of the Water Supply CIP in recent years. Other CIP projects focus on expanding in-lieu and direct recharge through recycled and purified water projects. Major water supply capital improvements identified in the CIP include:

   Storage:
   - Almaden Dam Improvements
   - Anderson Dam Seismic Retrofit
   - Calero Dam Seismic Retrofit
   - Guadalupe Dam Seismic Retrofit

   Transmission:
   - 10-Year Pipeline Rehabilitation
   - Fisheries and Aquatic Habitat Collaborative Effort (FAHCE) Implementation
   - Main and Madrone Pipeline Rehabilitation
   - Vasona Pumping Plant Upgrade

[9] The 2019-23 CIP is available at: https://www.valleywater.org/how-we-operate/five-year-capital-improvement-program

Treatment:
- Penitencia Water Treatment Plant Residuals Management
- Rinconada Water Treatment Plant Reliability Improvement

Recycled Water:
- Expedited Purified Water Program
- South County Recycled Water Pipeline

Detailed information on each of these water supply capital projects, including related description, costs, and schedule, is available in the CIP.

California WaterFix

On May 8, 2018, Valley Water Board voted to participate in the California WaterFix project, the state's proposed plan to improve the infrastructure that carries water through the Sacramento-San Joaquin Delta. This vote is in line with the Board's Oct. 17, 2017 vote which offered conditional support to the project and asked that the state consider a lower-cost, scaled-down and phased project. Valley Water will continue to engage in and negotiate financial arrangements and agreements to ensure local interests are served and Santa Clara County benefits are achieved.

Pacheco Reservoir Expansion Project

In conjunction with the San Benito County Water District and Pacheco Pass Water District, Valley Water is exploring the possibility of expanding the existing Pacheco Reservoir on the North Fork Pacheco Creek in south-east Santa Clara County. The reservoir is located 60 miles southeast of San Jose and sits north of Highway 152. The project will increase the reservoir's capacity from 5,500 to up to 140,000-acre feet. The Pacheco Reservoir Expansion Project will provide a number of benefits, including: reducing the frequency and severity of water shortages, increased emergency water supplies, augment groundwater recharge, provide surface water instead of groundwater pumping, improved water quality, providing flood protection for disadvantaged communities, ecosystems benefits through our region and the Sacramento-San Joaquin Delta, and protecting and growing the native steelhead population. The Pacheco Reservoir Expansion Project has been conditionally awarded the full amount requested by Valley Water of $484.55 million from the Proposition 1 Water Storage Investment Program (WSIP) fund, which also includes an early funding award of $24.2 million.

2. **Continue to aggressively protect groundwater quality through Valley Water programs and collaboration with land use agencies, regulatory agencies, and basin stakeholders.**

Sub-recommendations from the Plan include continued groundwater quality monitoring, action when potentially adverse trends are identified, and continued/enhanced collaboration with local partners and stakeholders.

Groundwater quality is typically very good in the county, with no treatment beyond disinfection required at major retailer wells. However, nitrate remains an ongoing groundwater protection challenge, particularly in the more rural Coyote Valley and Llagas Subbasin. Valley Water continues to conduct extensive groundwater quality monitoring, evaluate long-term trends, and compare current conditions against regulatory standards and projected concentrations (such as from Salt and Nutrient Management Plans). Detailed information and analysis of all monitoring data is presented in Valley Water's Annual Groundwater Report, which is calendar-year based and published each summer.[10]

Long-term trends are favorable for nitrate, with about 90% of wells tested showing stable or decreasing concentrations. However, since a significant number of domestic wells in the Llagas Subbasin still contain nitrate above the drinking water standard, more work remains to be done. Valley Water offers rebates of up to $500 for nitrate treatment systems and will continue to engage with regulatory and land use agencies to address existing nitrate contamination. For nitrate and other water quality issues, Valley Water will work to build and enhance this collaboration to protect high-quality groundwater and expedite the restoration of impacted groundwater.

Valley Water is working with land use agencies on a Stormwater Resources Plan to increase infiltration while ensuring pollutants from urban runoff are not merely transmitted from surface water to groundwater. Similarly, Valley Water continues to engage with various entities to ensure that recycled water expansion or the use of purified water for recharge will be protective of groundwater quality.

Engaging with land use and regulatory agencies on proposed policy, legislation, and projects that may impact groundwater remains a key strategy for protecting groundwater. For example, Valley Water tracks the progress of major contaminant release sites, interacting with regulatory agencies to promote expedited and thorough cleanup. Valley Water also engages with land use agencies on relevant projects and policies such as development, stormwater infiltration devices, septic systems, and small water systems.

Public outreach continues to be an important component of Valley Water's groundwater protection efforts. In WY 2018, Valley Water celebrated Groundwater Awareness Week (March 11-17) by highlighting groundwater on the Valley Water website and posting related social media messages. Valley Water also maintained its status as a Groundwater Guardian through a program sponsored by the non-profit Groundwater Foundation. This is an annually-earned designation for communities and affiliates that take voluntary, proactive steps toward groundwater protection.

To provide information on well sampling by Valley Water and local water suppliers, Valley Water prepared the 2017 Groundwater Quality Summary (Attachment 1). This is similar to water retailer consumer confidence reports and provides basic groundwater quality information to domestic well owners who do not typically receive water from a water retailer.

[10] The comprehensive Annual Groundwater Report for each calendar year is available at www.valleywater.org/groundwater.

Other groundwater-related public outreach conducted by Valley Water in WY 2018 included:

- Interaction with thousands of students through the Education Outreach program.
- Direct communication with well owners on groundwater quality, well maintenance, and treatment systems under the Domestic Well Testing and Nitrate Treatment System Rebate programs.

3. Continue to incorporate groundwater sustainability planning in Valley Water planning efforts.

This Plan recommendation focuses on continued, thoughtful water supply planning and investments. Valley Water is working to complete an update to the Water Supply Master Plan to address future challenges to water supply reliability and implement related projects as appropriate. Staff has held multiple workshops with water retailers and stakeholders, and presented information to the Board and the Board's Water Conservation and Demand Management Committee on numerous occasions. These presentations have included information on the proposed level of service target and potential water supply portfolios. All portfolios currently under consideration include the "No Regrets" package, which includes advanced metering infrastructure, leak repair incentives, expansion of our graywater program, a model ordinance for new developments, decentralized stormwater capture (e.g., incentives for rain barrels, cisterns, and rain gardens), and centralized stormwater capture (e.g., flooding of agricultural lands).

Groundwater sustainability also remains an important factor during the planning and implementation of multi-benefit projects under Valley Water's One Water Plan. The Sustainable Groundwater and Water Quality objectives of the One Water Plan align with the Plan outcome measures and the process to identify individual projects on the watershed scale (e.g., Coyote Watershed) accounts for groundwater conditions and sustainability.

In 2013, Valley Water established a project team to lead its managed response to climate change. A goal of the managed response includes preparing a Climate Change Action Plan (CCAP) by the end of 2019. The CCAP will include comprehensive review of climate change as it relates to Valley Water core services, and include actions Valley Water can take now and those it should continue to evaluate into the future. The CCAP will identify potential future climate change impacts, risks, and vulnerabilities on all core service areas, including water supply and groundwater management. Using this information, areas with potential impacts will be assessed to identify existing, enhanced, or new strategies to reduce risks to Valley Water core services and its mission. The strategies will be incorporated into existing Valley Water plans, budgets, and long-term financial forecasts as appropriate.

4. Maintain adequate monitoring programs and modeling tools.

This Plan recommendation focuses on: improving monitoring networks by identifying and addressing gaps, redundancies, and access issues; identifying and implementing improvements to the numerical groundwater flow models; and improving Valley Water's understanding of surface water/groundwater interaction.
To supplement regional groundwater quality monitoring (which emphasizes the use of consistent wells), Valley

Water continues to offer free basic well testing for domestic well owners. Through this voluntary program, Valley Water obtains valuable data on nitrate and other contaminants while providing important water quality data to about 200 private well owners each year.

Valley Water is currently evaluating the recycled water and recharge water quality monitoring networks to ensure they meet monitoring objectives in terms of frequency, locations, and constituents analyzed. For the three groundwater flow models used, Valley Water is assessing each model to identify related improvements or enhancements that may be needed or desired to improve the use of these tools.

In addition to the comprehensive, calendar-year based Annual Groundwater Report Valley Water produces high-level monthly Water Tracker[11] and groundwater condition reports[12] help keep stakeholders informed about current groundwater conditions including groundwater pumping, recharge, and water levels.

Regarding surface water/groundwater interaction, Valley Water staff has begun to evaluate existing available data for stream gauging and groundwater levels. Valley Water is also evaluating whether existing wells adjacent to creeks may be useful in collecting additional data to better understand the interaction. Staff has attended workshops organized by DWR and reviewed both relevant literature and how other GSAs are working to better understand groundwater-surface water interaction. Staff has also performed preliminary experiments to measure the flux between surface water and groundwater. Valley Water will continue to explore the complex and dynamic interaction between surface water and groundwater, and will engage interested stakeholders. This issue will be further documented in the five-year Groundwater Management Plan update, which is due in 2021.

5. Continue and enhance groundwater management partnerships with water retailers and land use agencies.

This Plan recommendation focuses on continued collaboration and strong partnerships with water retailers and land use agencies. Valley Water continues to interact regularly with water retailers through quarterly Water Retailer meetings, including the Groundwater Subcommittee. In addition to these regular meetings, Valley Water and water retailers collaborate on various issues that arise regarding groundwater, treated water, wells, and water measurement.

Valley Water also continues to coordinate with local land use agencies on General Plans, water supply assessments, Urban Water Management Plans, stormwater management, and various individual land use projects. Land use decisions fall under the authority of the local cities and the County of Santa Clara. Valley Water reviews land use and development plans related to Valley Water facilities and watercourses under Valley Water jurisdiction, and provides technical review for other land use proposals as requested by the local agency. When provided by land use agencies, water supply assessments for new developments are also reviewed and

[11] https://www.valleywater.org/your-water/water-supply-planning/monthly-water-tracker
[12] https://www.valleywater.org/your-water/where-your-water-comes-from/groundwater/groundwater-monitoring

evaluated in the context of Valley Water's long-term water supply plans. For all reviews, Valley Water's groundwater-related comments focus on potential impacts to groundwater quality and sustainability.

6. Evaluate the potential new authorities provided by SGMA.

The Santa Clara Valley Water District Act provides broad authorities, but there are additional authorities under SGMA including the ability to regulate pumping or impose various types of fees. This Plan recommendation focused on the evaluation of these new SGMA authorities in cooperation with water retailers and other interested stakeholders to consider what conditions might necessitate their implementation to sustainably manage groundwater into the future.

As described in the WY 2017 Report submitted to DWR, throughout 2017 Valley Water explored new SGMA authorities with interested stakeholders through the Board's Water Conservation and Demand Management Committee (Committee). Nine publicly-noticed Committee meetings between December 2016 and December 2017 provided a transparent forum for discussion with interested stakeholders on how and when these authorities might be used.

The potential regulation of pumping or well construction, a complex and controversial topic, was discussed extensively through Committee meetings. Existing groundwater management programs and strong partnerships with large pumpers are expected to result in continued sustainable conditions and are the preferred way to address future challenges. However, pumping regulation may be needed in the future to address undesirable results, should they occur or be projected to occur. The primary SGMA-related work product from the Committee meetings was a process that describes the fundamental approach to respond to worsening basin conditions. This includes the steps that would be taken prior to implementing SGMA authorities to regulate groundwater pumping, with a focus on providing some certainty on the process, while avoiding prescriptive requirements that may not be effective in addressing a future issue. This process was memorialized via a resolution adopted by Valley Water Board on February 27, 2018 (Attachment 2).

Valley Water also explored the potential to implement a fixed charge as a component of groundwater production charges, which are currently volumetric charges. This could potentially reduce volatility in rates and revenues based on changes in water use. Valley Water engaged a consultant to develop a fixed charge proposal and assist with implementation. However, major water retailers expressed significant concerns, including redundancy with other charges or charge adjustment mechanisms, equity in applying the charge to all well users, and potential cost recovery impacts to retailers regulated by the California Public Utilities Commission. After discussing these concerns with the Committee and the full Board, Valley Water is unlikely to further pursue a fixed charge at this time.

NEXT STEPS

Valley Water will continue to submit annual reports required under SGMA to DWR by the April 1 deadline. In addition to this brief report, Valley Water will also continue to publish a comprehensive, calendar-year based Annual Groundwater Report each summer with more detailed information on pumping, recharge, water balance, groundwater levels and storage, land subsidence and groundwater quality. The most recent report, the Annual Groundwater Report for Calendar Year (CY) 2017, is posted on the Valley Water website, and will be replaced with the CY 2018 Report in the summer of 2019.[13]

Ensuring continued groundwater sustainability is central to the Valley Water mission to provide Silicon Valley a safe, clean water supply for a healthy life, environment, and economy. As such, Valley Water will continue to "aggressively protect groundwater from the threat of contamination and maintain and develop groundwater to optimize reliability and to minimize land subsidence and salt water intrusion," in accordance with Board policy.

The remainder of this page is intentionally left blank

[13] https://www.valleywater.org/your-water/where-your-water-comes-from/groundwater

Attachment 1

Annual Groundwater Quality Summary Report

for Testing Performed in Calendar Year 2017

Annual Groundwater Quality Summary Report

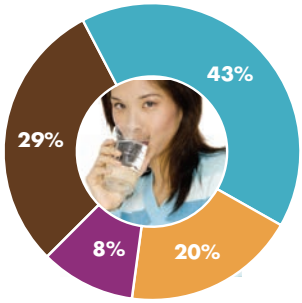
For Testing Performed in 2017

Santa Clara Valley Water District

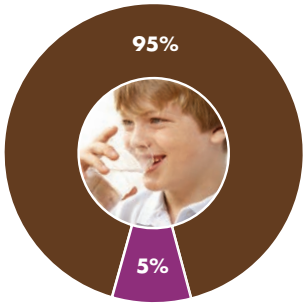
Protecting our Groundwater

Groundwater is an essential local water resource, providing about half of the water used in Santa Clara County each year. In some areas, groundwater is the only source of drinking water. Protecting our groundwater helps ensure that adequate supplies are available now and in the future.

NORTH COUNTY WATER USE



SOUTH COUNTY WATER USE



- Groundwater
- Treated Water
- Hetch-Hetchy
- Other Local and Recycled Water

The Santa Clara Valley Water District works to safeguard groundwater by:

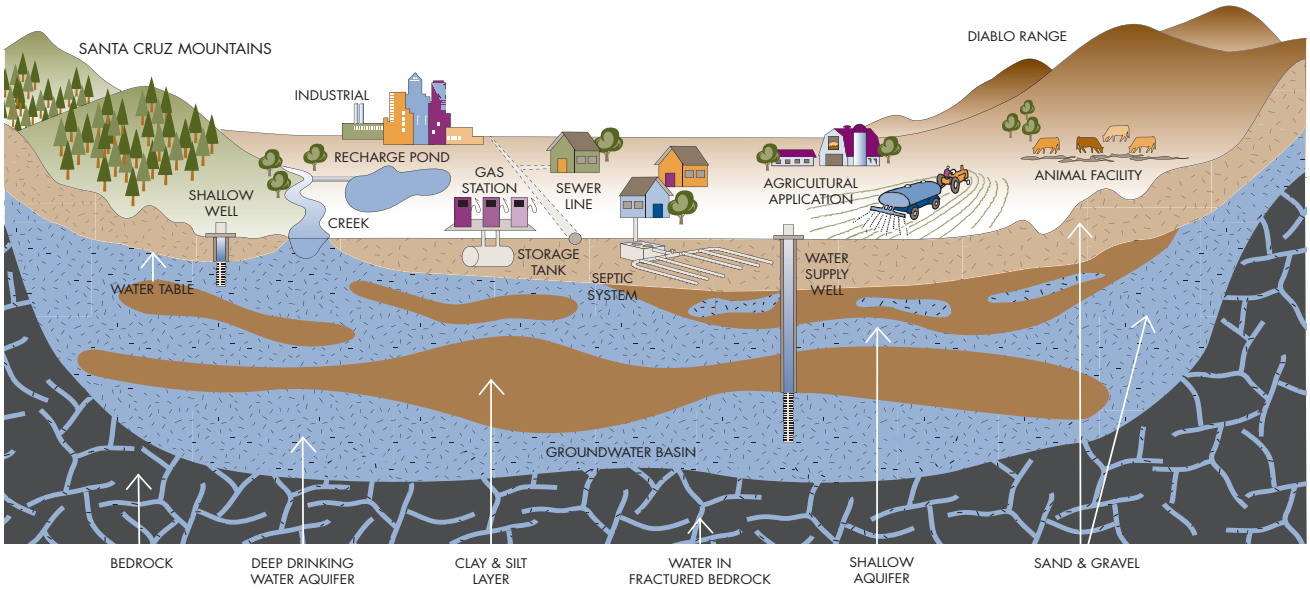
- Replenishing groundwater basins with local and imported surface water.
- Reducing demands on groundwater through the delivery of treated water, water conservation, and water recycling.
- Monitoring groundwater and conducting programs to protect against contamination.

Well water testing throughout the county indicates that groundwater quality is generally very good. All drinking water, including bottled water, trail closure, contains small amounts of some contaminants. As water travels over the surface of the land and through the ground, it dissolves naturally occurring minerals and can pick up substances from animal and human activities.

Contaminants that may be present in groundwater include:

- Microbial contaminants such as viruses and bacteria that may come from sewage treatment plants, sewer lines, septic systems, agricultural operations, and wildlife.
- Inorganic contaminants such as salts and metals that can be naturally occurring or result from industrial or domestic wastewater discharges, animal facilities, farming, and mining.
- Insecticides, herbicides, and fertilizers, that may come from agriculture, and residential uses.
- Organic chemicals from industrial processes, gas stations, dry cleaners, agricultural application, and septic systems.
- Radioactive contaminants that are naturally occurring in our area.

The presence of contaminants does not necessarily indicate that water poses a health risk. State and federal drinking water standards identify maximum contaminant levels that relate to health risk.



2017 Groundwater Quality Summary

Monitoring confirms generally high groundwater quality, but South County nitrate is a concern

In 2017, the water district sampled over 290 domestic wells and evaluated data from another 225 public water supply wells in North and South County (see map on back page). Nearly all wells tested meet drinking water standards with the notable exception of nitrate in some South County domestic wells. The water district works with regulatory and land use agencies on this ongoing challenge.

The table below summarizes the results for any substance detected in a domestic or public water supply well in 2017; not every well was tested for all substances listed. Although Maximum Contaminant Levels (MCLs) apply only to public water systems, MCLs are helpful in understanding results from domestic wells. Please note this regional summary may not reflect the water quality in every well since each property and well is unique.

Primary Drinking Water Standards – Public Health Related Standards				North County		South County		
Inorganic Contaminants	**Units**	**Maximum Contaminant Level**	**Public Health Goal**	**Medium**	**Range**	**Medium**	**Range**	**Typical Sources**
Aluminum	ppb	1,000	600	3.18	ND - 1,700	11.1	ND - 820	Erosion of natural deposits
Antimony	ppb	6	1	ND	ND	ND	ND - 9.9	Discharge from petroleum refineries; fire retardants; ceramics; electronics; solder
Arsenic	ppb	10	0.004	ND	ND - 4	ND	ND - 4	Erosion of natural deposits; glass and electronics production waste
Asbestos	MFL	7	7	ND	ND - 0.7	2.99	ND - 18	Erosion of natural deposits
Barium	ppb	1,000	2,000	135	ND - 310	97.9	ND - 300	Erosion of natural deposits
Chromium (total)	ppb	50	–	1.10	ND - 1.7	1.20	ND - 3.8	Erosion of natural deposits; metal plating
Chromium-6 (hexavalent)	ppb	–	0.02	2.20	ND - 7.9	4.00	ND - 7.8	Erosion of natural deposits; metal plating and industrial discharges
Fluoride	ppm	2	1	0.141	ND - 0.84	0.150	ND - 1.06	Erosion of natural deposits
Mercury	ppb	2	1.2	ND	ND - 1.9	ND	ND	Erosion of natural deposits; discharge from refineries and factories; runoff from landfills and cropland
Nickel	ppb	100	12	1.20	ND - 16	ND	ND - 4.5	Erosion of natural deposits; discharge from metal industries
Nitrate + Nitrite (as N)	ppm	10	10	2.40	ND - 6.1	3.40	0.41 - 7.1	Runoff and leaching from fertilizer use; leaching from septic tanks and sewage; erosion of natural deposits
Nitrate (as N)	ppm	10	10	3.00	ND - 29.2	6.13	0.06 - 73.7	Runoff and leaching from fertilizer use; leaching from septic tanks and sewage; erosion of natural deposits
Perchlorate	ppb	6	1	ND	ND	ND	ND - 4.5	Solid rocket propellant, fireworks, explosives, flares, matches, and a variety of industries
Selenium	ppb	50	30	6	ND - 11	ND	ND - 5	Erosion of natural deposits
Radioactive Contaminants								
Gross Alpha	pCi/L	15	–	2	ND - 8.3	ND	ND - 0.43	Erosion of natural deposits
Gross Beta	mrem/yr	4	–	–	–	0.148	0.148	Erosion of natural deposits
Radium 226	pCi/L	–	0.05	ND	ND	0.128	0.128	Erosion of natural deposits
Tritium	pCi/L	20,000	400	–	–	170	170	Erosion of natural deposits
Uranium	pCi/L	20	0.43	ND	ND	0.294	0.294	Erosion of natural deposits
Volatile Organic Chemicals								
1,1,1-Trichloroethane (1,1,1-TCA)	ppb	200	1,000	ND	ND - 1.2	ND	ND	Discharge from metal degreasing sites and other industrial processes
1,1-Dichloroethene (1,1-DCE)	ppb	6	10	ND	ND - 0.87	ND	ND	Discharge from industrial processes
Haloaccetic Acids (HAA5)	ppb	60	–	4.40	4.40	–	–	Drinking water chlorination
Tetrachloroethene (PCE)	ppb	5	0.06	ND	ND	ND	ND - 2.2	Discharge from industrial processes, dry cleaners, and automotive repair
Total Trihaloethanes (THMs)	ppb	80	–	ND	ND - 21.2	ND	ND - 1.6	Drinking water chlorination
Microbiological Contaminants[1]				**Present**	**Absent**	**Present**	**Absent**	**Typical Sources**
E. Coli Bacteria		–	–	4	23	5	263	Human and animal fecal waste
Total Coliform Bacteria		–	–	11	16	91	177	Naturally present in the environment

Notes: 1) The table shows the number of domestic wells tested that had bacteria present or absent. Public water systems are required to ensure that fewer than 5% of samples have total coliform present and that no samples have e.coli present. Domestic wells are not subject to these standards.

Terms and Definitions

Color units: A measure of color in water

Maximum Contaminant Level (MCL): The highest level of a contaminant allowed in public water systems. Primary MCLs are set as close to PHGs as is economically and technologically feasible. Secondary MCLs protect the odor, taste, and appearance of drinking water.

Median: The "middle" value of the results, with half of the values above the median and half of the values below the median.

MFL: Million Fibers per Liter

mrem/yr: Millirems per year

ND: Not detected (at laboratory testing limit)

NTU: Nephelometric Turbidity Units

pCi/L: picoCuries per liter (a measure of radiation)

– Indicates there is no related drinking water standard, or that the substance was not tested.

ppm: parts per million (milligrams per liter)

ppb: parts per billion (micrograms per liter)

Public Health Goal (PHG): The level of a contaminant in drinking water below which there is no known or expected risk to human health. PHGs are set by the California EPA.

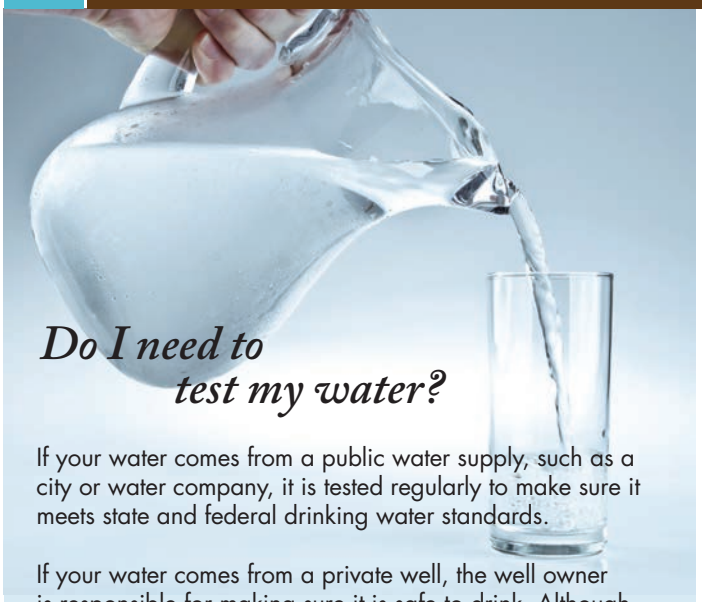
TON: Threshold Odor Number

uS/cm: microSiemens per centimeter (a measure of the dissolved inorganic salt content)

2017 Groundwater Quality Summary

Secondary Drinking Water Standards – Aesthetic Standards	Units	Maximum Contaminant Level	Public Health Goal	North County Medium	North County Range	South County Medium	South County Range	Typical Sources
Chloride	ppm	250	–	49.0	13 - 89	46.0	17 - 135	Runoff/leaching from natural deposits; seawater influence
Color	Color Units	15	–	5.00	ND - 31	6.00	ND - 9	Naturally occurring organic materials
Copper[1]	ppb	1,000	300	1.80	1.4 - 120	3.10	ND - 16.6	Internal corrosion of household plumbing systems; erosion of natural deposits
Foaming Agents (MBAS)	ppb	500	–	ND	ND - 0.1	ND	ND	Municipal and industrial waste discharges
Iron	ppb	300	–	51.9	41 - 3,900	2.71	26 - 6,300	Leaching from natural deposits; industrial wastes
Manganese	ppb	50	–	2.69	ND - 240	0.745	ND - 1,200	Leaching from natural deposits; industrial wastes
Odor Threshold	TON	3	–	ND	ND - 1.4	ND	ND	Naturally occurring organic materials
pH	pH units	6.5 - 8.5	–	7.53	6.23 - 8.1	7.75	7.45 - 8	Erosion of natural deposits; carbon dioxide emissions; rainfall
Specific Conductance	uS/cm	900	–	664	349 - 1,840	655	299 - 2,380	Substances that form ions when in water; seawater influence
Sulfate	ppm	250	–	47.0	3.6 - 196	38.0	ND - 224	Runoff/leaching from natural deposits; industrial wastes
Total Dissolved Solids (TDS)	ppm	500	–	400	270 - 1,100	376	244 - 608	Runoff/leaching from natural deposits
Turbidity	NTU	5	–	0.460	ND - 4.9	0.205	ND - 2	Soil runoff
Zinc	ppb	5,000	–	0.865	ND - 670	4.17	ND - 340	Runoff/leaching from natural deposits; industrial wastes
Other Water Quality Parameters								
Alkalinity (total, as CaCO3)	ppm	–	–	220	120 - 380	179	93 - 344	Atmospheric and vadose zone carbon dioxide
Boron	ppb	–	–	ND	ND - 506	120	ND - 2,000	Erosion of natural deposits
Bromide	ppm	–	–	0.140	ND - 0.49	0.160	ND - 1.56	Erosion of natural deposits; seawater intrusion; sea spray
Bromodichloromethane (THM)	ppb	–	–	ND	ND - 5.5	ND	ND	Drinking water chlorination
Bromoform (THM)	ppb	–	–	ND	ND - 5.4	ND	ND	Drinking water chlorination
Calcium	ppm	–	–	63.0	23.5 - 110	53.1	32.9 - 99.6	Erosion of natural deposits
Carbon dioxide	ppb	–	–	8.13	ND - 240	ND	ND	Atmospheric sources; dissolution of carbonate rocks
Carbonate (as CO3)	ppm	–	–	ND	ND - 2	ND	ND	Atmospheric sources; dissolution of carbonate rocks
Chloroform (THM)	ppb	–	–	ND	ND - 2.74	ND	ND - 1.6	Drinking water chlorination
Cobalt	ppb	–	–	ND	ND - 0.21	ND	ND	Leaching from natural deposits; industrial wastes
DCPA (Total Di & Mono Acid Degradates)	ppb	–	–	ND	ND - 0.7	ND	ND	Herbicide used to control grasses and weeds
Dibromochloromethane (THM)	ppb	–	–	ND	ND - 7.9	ND	ND	Drinking water chlorination
Dichloroacetic Acid	ppb	–	–	2.7	2.7	–	–	Drinking water chlorination
Hardness (total, as CaCO3)	ppm	–	–	290	122 - 636	271	ND - 728	Erosion of natural deposits
Lead[1]	ppb	–	0.2	0.390	ND - 16	ND	ND - 2.35[2]	Erosion of natural deposits; internal corrosion of household water plumbing systems; discharges from industrial manufacturers
Lithium	ppb	–	–	5.60	ND - 25	10.0	ND - 28	Erosion of natural deposits; discharge from industrial uses
Magnesium	ppm	–	–	29.1	8.2 - 67	31.0	17 - 59.2	Erosion of natural deposits
Molybdenum	ppb	–	–	0.900	ND - 5.1	ND	ND - 3.5	Erosion of natural deposits
Monobromoacetic Acid (MBAA)	ppb	–	–	1.7	1.7	–	–	Drinking water chlorination
Orthophosphate	ppm	–	–	0.070	ND - 2.3	ND	ND - 1.56	Leaching from natural deposits; agricultural runoff
Potassium	ppm	–	–	1.30	ND - 2.1	1.25	ND - 2.1	Erosion of natural deposits
Silica	ppm	–	–	26.7	25 - 28.4	27.1	12 - 47.7	Erosion of natural deposits
Sodium	ppm	–	–	32.0	15 - 84.8	26.0	13.2 - 80.5	Erosion of natural deposits
Vanadium	ppb	–	–	2.79	ND - 13.5	1.70	ND -14	Erosion of natural deposits; discharge from industrial uses

Notes:
1) Lead and copper do not have primary MCLs, but have "action levels" of 15 and 1,300 ppb, respectively. These substances are regulated by the state for public water systems since they can adversely affect public health.
2) One high lead result (1,000 ppb) was not confirmed by follow-up testing. The next highest level measured was 2.35 ppb as shown.
– Indicates there is no related drinking water standard, or that the substance was not tested.



Do I need to test my water?

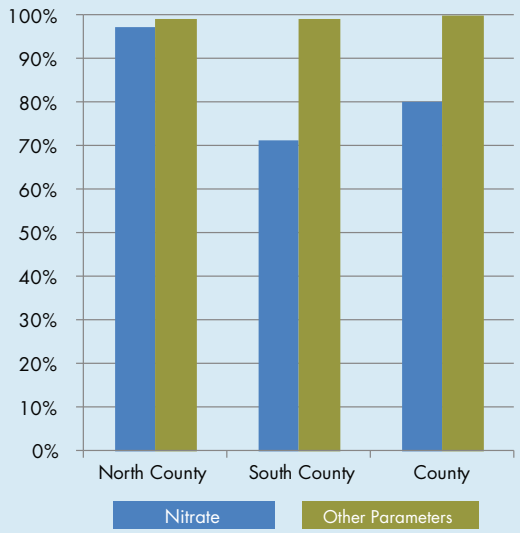
If your water comes from a public water supply, such as a city or water company, it is tested regularly to make sure it meets state and federal drinking water standards.

If your water comes from a private well, the well owner is responsible for making sure it is safe to drink. Although the water district monitors regional groundwater quality, every property and well is unique. Some contaminants are colorless and odorless, so the first step in protecting your health is having your water tested.

The water district encourages private well owners to have their well water tested by a state-certified laboratory annually or anytime there is a change in taste, odor, or appearance. If your water contains any contaminant above drinking water standards, you may want to install a treatment system or use an alternative source of water.

The water district currently offers eligible domestic well users free basic water quality testing and rebates of up to $500 for nitrate treatment systems. Call the Groundwater Hotline at (408) 630-2300 to find out more.

WATER SUPPLY WELLS TESTED IN 2017 MEETING PRIMARY DRINKING WATER STANDARDS



Everyone has a role in protecting groundwater. Well owners should maintain their wells and septic systems, and create a zone of protection around their wells where potential contaminants are not used or stored. See the water district's Guide for the Private Well Owner at www.valleywater.org for helpful tips. All residents can help by conserving water and by raising awareness that activities on the land surface can affect our largest drinking water reservoir, which is beneath our feet.

Hot Topics in Water Quality

Nitrate

As shown in the chart to the left, nitrate is an ongoing challenge, particularly in South County. Common sources are fertilizers, septic systems and livestock waste, so nitrate is often higher in rural and agricultural areas.

Nitrate can interfere with the blood's ability to transport oxygen and is of greatest concern for infants and pregnant women. The effects of consuming high levels of nitrate are often referred to as "blue baby syndrome" and symptoms include shortness of breath and blueness of the skin.

The water district monitors nitrate conditions and trends, helps dilute nitrate through groundwater recharge, and works with land use and regulatory agencies. To help reduce domestic well owners' exposure to elevated nitrate, the water district is offering rebates of up to $500 for eligible treatment systems. Call the Groundwater Hotline at (408) 630-2300 for more information.

Perchlorate

Perchlorate is a salt used in rocket fuel, highway flares, fireworks and other products. At high levels, perchlorate can interfere with the thyroid gland and affect hormones that regulate metabolism and growth.

Perchlorate contamination from a former highway flare manufacturer in Morgan Hill was first discovered in 2000. At the urging of the water district and the community, the Central Coast Regional Water Quality Board has taken timely action to restore groundwater quality.

Due to cleanup activities and groundwater recharge, perchlorate levels have decreased dramatically. The area affected is getting smaller, now extending from Tennant Avenue south to approximately San Martin Avenue. The responsible party continues to remediate and monitor contaminated groundwater, and provides treatment systems or alternative water supplies for water supply wells with high levels of perchlorate (currently six).

You live on a groundwater basin

NORTH COUNTY
Generally extends north from Metcalf Road to San Francisco Bay

SOUTH COUNTY
Extends from the Coyote Valley south to the Pajaro River

Health and education information

All drinking water, including bottled water, may reasonably be expected to contain small amounts of some contaminants. The presence of contaminants does not necessarily indicate that the water poses a health risk. More information about contaminants and potential health effects can be obtained from the U.S. Environmental Protection Agency's Safe Drinking Water Hotline **(800-426-4791),** the California Division of Drinking Water **(www.waterboards.ca.gov/drinking_water/programs)**, the California Office of Environmental Health Hazard Assessment **(*www.oehha.ca.gov/water*)**, or from your healthcare provider.

CONTACT US

For more information, contact us at **(408) 630-2964** or by email at **gcook@valleywater.org.** Or use our **Access Valley Water** customer request and information system at valleywater.org to find out the latest information on district projects or to submit questions, complaints or compliments directly to a district staff person.

Follow us on: /scvwd /valleywater /valleywater

To get eNews, drop an email to: info@valleywater.org

©2018 Santa Clara Valley Water District • 5/18 • SK

Attachment 2

Resolution Memorializing the Process to Regulate Groundwater Extraction Under the Sustainable Groundwater Management Act, if Needed

BOARD OF DIRECTORS
SANTA CLARA VALLEY WATER DISTRICT

RESOLUTION NO. 18- 04

RESOLUTION MEMORIALIZING THE PROCESS TO REGULATE GROUNDWATER EXTRACTION UNDER THE SUSTAINABLE GROUNDWATER MANAGEMENT ACT, IF NEEDED

WHEREAS, the Santa Clara Valley Water District Act (California Water Code Appendix, Chapter 60) provides the District with broad groundwater management authority, including the authority to protect, spread, store, retain, and cause water to percolate in the soil within Santa Clara County; and

WHEREAS, on September 16, 2014, the Sustainable Groundwater Management Act (SGMA) was signed into law and adopted into the California Water Code, commencing with Section 10720; and

WHEREAS, Water Code Section 10720.1 states that, in enacting SGMA, the intent of the legislature is to provide for the sustainable management of groundwater basins, to enhance local management of groundwater consistent with rights to use or store groundwater, to establish minimum standards for sustainable groundwater management, to provide local groundwater agencies with the authority and the technical and financial assistance necessary to sustainably manage groundwater, and to achieve other listed intents; and

WHEREAS, on May 24, 2016, the District Board of Directors adopted Resolution 16-51 on the Decision to Become the Groundwater Sustainability Agency (GSA) for the Santa Clara and Llagas Subbasins; and

WHEREAS, on June 13, 2017, the District Board of Directors adopted Resolution 17-38 on the Decision to Become the GSA for the Portions of the Hollister and San Juan Bautista Subbasins Located Within Santa Clara County; and

WHEREAS, Water Code Section 10733.6(b)(1) identifies a plan developed pursuant to Part 2.75 (commencing with Section 10750) or other law authorizing groundwater management as an acceptable alternative to a Groundwater Sustainability Plan; and

WHEREAS, the 2016 Groundwater Management Plan (GWMP) describes the District's comprehensive framework to ensure continued, sustainable groundwater conditions in the Santa Clara and Llagas Subbasins; and

WHEREAS, on November 22, 2016, the District Board of Directors adopted the GWMP through Resolution 16-78; and

WHEREAS, the District submitted the GWMP to the California Department of Water Resources as an alternative pursuant to SGMA; and

WHEREAS, the GWMP acknowledges new authorities granted by SGMA, including the potential to regulate groundwater extraction, control well spacing or operation, and collect different types of fees, within the constraints identified in SGMA; and

Resolution Memorializing the Process to Regulate Groundwater Extraction under the Sustainable Groundwater Management Act, if Needed — Resolution No. 18- 04

WHEREAS, the existing groundwater management framework, which includes coordination with water retailers and other stakeholders, is expected to support continued, sustainable groundwater conditions; and

WHEREAS, the District Board of Directors directed the Water Conservation and Demand Management Committee (Committee) to engage stakeholders in evaluating the new SGMA authorities as potential tools that may be needed to ensure continued sustainability; and

WHEREAS, the Committee engaged water retailers and other interested stakeholders during nine publicly-noticed meetings between December 2016 and December 2017; and

WHEREAS, the Committee considered stakeholder input in developing the Process to Regulate Groundwater Extraction under the Sustainable Groundwater Management Act, if Needed, attached hereto as Exhibit A; and

WHEREAS, the Process to Regulate Groundwater Extraction under the Sustainable Groundwater Management Act, if Needed, describes the approach to respond to worsening basin conditions, including the steps that would be taken prior to implementing SGMA authorities to regulate extraction.

NOW, THEREFORE BE IT RESOLVED that the Board of Directors of the Santa Clara Valley Water District:

1. Hereby adopts the Process to Regulate Groundwater Extraction under the Sustainable Groundwater Management Act, if Needed; and

2. All the recitals in this Resolution are true and correct and the District so finds, determines, and represents.

PASSED AND ADOPTED by the Board of Directors of the Santa Clara Valley Water District by the following vote on February 27, 2018:

AYES: Directors N. Hsueh, T. Estremera, B. Keegan, G, Kremen, L. LeZotte, J. Varela, R. Santos

NOES: Directors None

ABSENT: Directors None

ABSTAIN: Directors None

SANTA CLARA VALLEY WATER DISTRICT

By: Richard P. Santos

RICHARD P. SANTOS
Chair/Board of Directors

ATTEST: MICHELE L. KING, CMC

Michele L. King

Clerk/Board of Directors

EXHIBIT A
COVERSHEET

PROCESS TO REGULATE GROUNDWATER EXTRACTION UNDER THE SUSTAINABLE GROUNDWATER MANAGEMENT ACT, IF NEEDED

No. of Pages:	6
Exhibit Attachment:	Attachment 1: Process to Regulate Groundwater Extraction under the Sustainable Groundwater Management Act, if Needed

Resolution No. 18-04

PROCESS TO REGULATE GROUNDWATER EXTRACTION UNDER THE SUSTAINABLE GROUNDWATER MANAGEMENT ACT, IF NEEDED

INTRODUCTION

The Santa Clara Valley Water District (District) has sustainably managed the Santa Clara and Llagas Subbasins for many decades under the authority of the District Act. In 2014, the Sustainable Groundwater Management Act (SGMA) was enacted as California's first comprehensive, statewide regulatory program for groundwater. SGMA provides Groundwater Sustainability Agencies (GSAs), like the District, with various authorities to manage groundwater.

SGMA authorities include the ability to regulate pumping and assess different types of groundwater charges. These authorities have been discussed in various meetings of the District Board of Directors (Board) Water Conservation and Demand Management Committee (Committee) in an open forum and with input from interested stakeholders.

The existing, proven groundwater management approach, which includes strong partnerships with large groundwater pumpers, is expected to result in continued, sustainable groundwater management in the future and is the preferred approach to addressing future challenges. This document describes the approach to implementing SGMA authorities to regulate groundwater extraction, should such regulation become needed in the future.

BACKGROUND

SGMA established new requirements for GSAs, including the development of Groundwater Sustainability Plans (GSPs) or prescribed Alternatives. In 2016, the District prepared the 2016 Groundwater Management Plan (GWMP), which was approved by the Board following a public hearing on November 22, 2016. The District submitted the GWMP as an alternative to a GSP to the California Department of Water Resources (DWR) in December 2016. The GWMP acknowledged the new SGMA authorities and committed the District to work collaboratively with groundwater pumpers and other stakeholders to further evaluate the authorities. The Board referred related stakeholder engagement to the Committee.

The Committee, stakeholders, and the Board have indicated interest in the use of a fixed charge as a component of the groundwater production charge, and the District will further explore this concept. Committee items on the potential regulation of pumping and related discussion with stakeholders have led to the development of this process, or implementation framework.

SGMA provides GSAs with various authorities to ensure groundwater management and use do not cause undesirable results, which are defined as one of more of the following per Water Code §10721:

1. Chronic lowering of groundwater levels indicating a significant and unreasonable depletion of supply if continued over the planning and implementation horizon.
2. Significant and unreasonable reduction of groundwater storage.
3. Significant and unreasonable seawater intrusion.
4. Significant and unreasonable degraded water quality, including the migration of contaminant plumes that impair water supplies.

Resolution No. 18-04

5. Significant and unreasonable land subsidence that substantially interferes with surface land uses.
6. Depletions of interconnected surface water that have significant and unreasonable adverse impacts on beneficial uses of the surface water.

Per Water Code §10726.4(a), in regulating groundwater extraction, SGMA allows a GSA to:

1. impose spacing requirements on new wells and impose reasonable operating regulations on existing wells to minimize well interference by restricting or suspending well production;
2. control groundwater extractions by regulating, limiting, or suspending extractions, new well construction, well enlargement, or abandoned well reactivation, or by establishing allocations;
3. authorize temporary and permanent transfers of extraction allocations; and
4. establish rules to allow unused extraction allocations to be carried over from one year to another and voluntarily transferred.

However, SGMA acknowledges limitations on the regulation of pumping. Local agencies are not authorized to make a binding determination of the water rights of any person or entity (Water Code §§ 10720.5(b) and 10726.8(b)). Also, any actions to control extractions generally must be consistent with the city or county general plans (Water Code §§ 10726.4, 10726.8(f), and 10726.9).

Research into the use of similar authorities in other jurisdictions indicates that few agencies regulate pumping, and highlights related challenges. Where used, pumping regulation has been in response to significant basin problems like long-term overdraft or salt water intrusion, most commonly through the well permitting process. These agencies have struggled with well owner concerns, enforcement, and legal challenges. Others have decided against regulation due to concerns with water rights and the potential to trigger adjudication, focusing instead on financial incentives or groundwater replenishment.

GUIDING PRINCIPLES

The District's existing groundwater management framework has maintained sustainable groundwater conditions over many decades. This proven framework, including strong collaboration with stakeholders, is the preferred approach to address future challenges. However, SGMA authorities are available as potential tools if the need arises. The process to regulate groundwater extraction, if needed, is based on these guiding District principles:

1. The District will sustainably manage local groundwater as part of our mission to provide Silicon Valley safe, clean water for a healthy life, environment, and economy.
2. The District will continue to conduct comprehensive water supply planning and invest in diverse water supplies to ensure reliability and avoid chronic shortages.
3. Through ongoing water supply operations, the District will continue to optimize the use of available water supplies while protecting groundwater storage.
4. Transparency in fulfilling the District mission remains an important driver and the District will continue to encourage input and participation from all interested stakeholders.

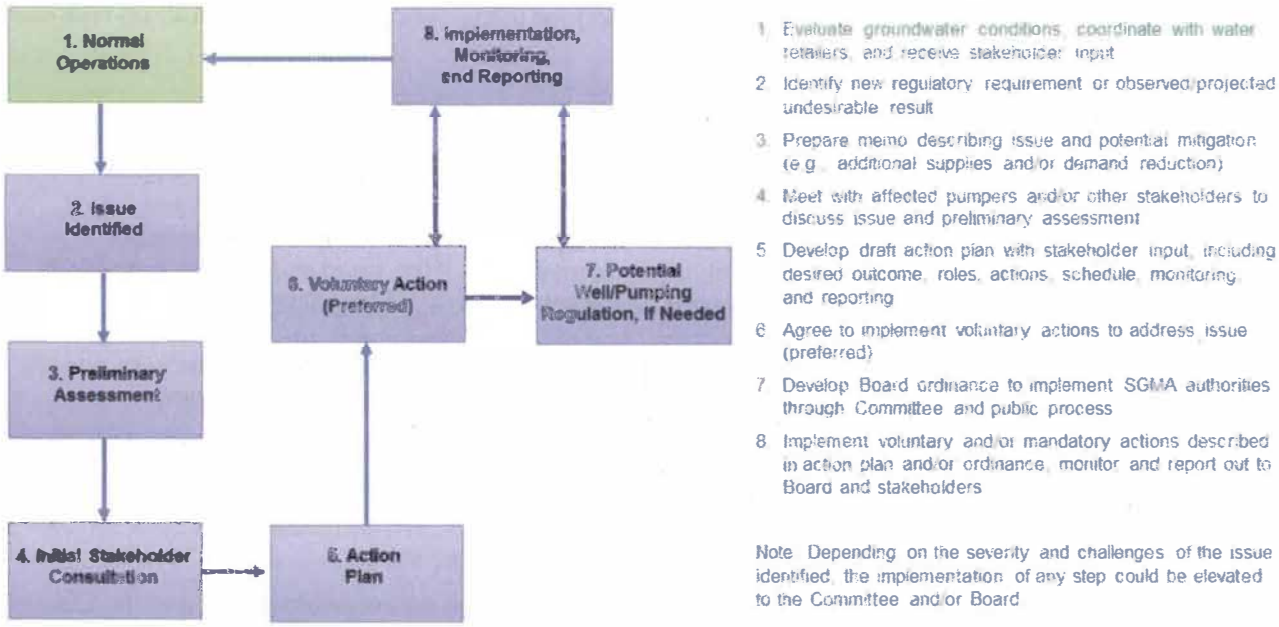
Resolution No. 18-04

5. The District will continue to seek solutions that effectively and efficiently address identified water supply issues as they arise.
6. The District will work with water retailers and other stakeholders to continue to improve our understanding and management of groundwater basins and conditions, including sustainable use.
7. Strong partnerships with water retailers and other large groundwater users have been effective in avoiding undesirable results and are critical to future sustainability.
8. Collaboration with groundwater users and interested stakeholders will continue to be the preferred approach to address observed or projected undesirable results, and District regulation of pumping will only be considered if there is no viable alternative.
9. Given the uncertainty in the timing, location, and severity of potential future undesirable results, the process to regulate groundwater extraction avoids prescriptive triggers and requirements; instead, it clarifies how to respond to worsening conditions. This will maintain maximum flexibility to respond to changing conditions and avoid unnecessary or ineffective actions.

PROCESS TO REGULATE GROUNDWATER EXTRACTION, IF NEEDED

The existing groundwater management framework is expected to support continued, sustainable conditions, and pumping regulation may never be needed. The process described below and summarized in Figure 1 describes the fundamental approach to respond to worsening basin conditions, including the steps that would be taken prior to implementing SGMA authorities to regulate extraction. As mentioned above, the focus is on providing certainty as to the process, while avoiding prescriptive requirements that may not be appropriate. This process allows for moving between the various steps linearly or using feedback loops.

Figure 1. Process to Regulate Groundwater Extraction, if Needed



Resolution No. 18-04

Step 1: Normal Operations

Comprehensive planning through the District's Urban Water Management Plan and Water Supply Master Plan ensures long-term water supply reliability (including groundwater) in accordance with level of service targets. Development of these plans includes coordination with water retailers and land use agencies, and the District encourages input from interested stakeholders. This regular, proactive planning avoids chronic shortages.

Operations planning helps meet near-term demands, protect groundwater reserves, and ensure adequate carryover supplies. Through this ongoing process, District staff develops operations scenarios based on the availability of imported and local supplies, including their optimal use and distribution. Water supply conditions are discussed with water retailers at least quarterly through Water Retailers Committee and Groundwater Subcommittee meetings, but operational or water supply issues often require more frequent communication and coordination. Current water supply information is also communicated to interested stakeholders through monthly Water Tracker updates and Groundwater Condition Reports, and the availability of groundwater level and other water supply data at www.valleywater.org.

Receiving input on groundwater management issues from interested stakeholders is an important part of normal operations. Accordingly, the District maintains a list of interested parties that includes water retailers, land use agencies, regulatory agencies, adjacent GSAs, non-governmental organizations, community groups, agricultural users, and private individuals, among others. The District notifies these interested parties of upcoming groundwater-related Board and Committee items and relevant information such as completion of the Annual Groundwater Report. The District also provides updates to all well owners on general topics of interest through regular mailings.

The District will continue to explore ways to ensure interested stakeholders are aware of groundwater management activities and opportunities for engagement, including participation in public meetings, Board correspondence, Access Valley Water inquiries, or direct communication with staff. The District evaluates all input and inquiries to determine if additional action is needed to protect groundwater resources.

Step 2: Issue Identified

Through the ongoing assessment of groundwater conditions described above, an issue requiring further action may be identified. This could be a new regulatory requirement, such as the need to limit water supply well construction near an indirect potable reuse project, or an observed or projected undesirable result as defined in Water Code §10721 and listed above. The GWMP identifies numeric outcome measures related to groundwater conditions that indicate the need for action; observed or projected failure to meet one of the outcome measures could lead to an undesirable result. There may also be unanticipated situations that do not trigger failure of an outcome measure, but require action to protect groundwater resources. If an issue requiring further action is identified, the District will inform potentially affected stakeholders and immediately move to the next step in the process.

Step 3: Preliminary Assessment

Once an issue requiring further action has been identified, District staff will use available information to evaluate the issue and summarize the findings in a technical memorandum. The memorandum will describe the nature and extent of impacts, suspected cause(s), potential

effects of taking no action, and potential mitigation options. These options may include District action, such as more focused monitoring, recommended shortage response per the Water Shortage Contingency Plan, efforts to acquire supplemental supplies, or incentives for the use of treated water. Mitigation options could also include the reduction of pumping within the impacted area.

Step 4: Initial Stakeholder Consultation

After completing the prior step, District staff will meet with selected stakeholders within the affected area to discuss groundwater conditions and the preliminary assessment. This initial consultation targets those likely needing to take action to help address the issue. In most cases this is expected to include higher-volume pumpers like water retailers that more strongly influence basin conditions. Depending on the nature of the issue, other affected stakeholders may also be consulted during this stage.

The District will work with stakeholders to evaluate additional data and update the preliminary assessment as necessary. The District and affected stakeholders will identify the schedule to develop an action plan as well as related roles and responsibilities.

It should be noted that this consultation may result in quick consensus on the need to act and what needs to be done. This occurred in 2014 when the District met with staff from the San Jose Water Company and the City of Santa Clara to discuss concerns with groundwater levels approaching subsidence thresholds within their service areas. In that case, a single meeting led to quick agreement on the need to voluntarily adjust pumping. This process is intended to support similar decisive action at the staff level when possible.

Step 5: Action Plan

Based on the timeline and roles identified during the initial stakeholder consultation, District staff and/or affected stakeholders will develop a draft action plan to address the issue. This action plan will identify the desired outcome and clearly define actions needed, roles and responsibilities, implementation schedule, and how the issue will be monitored. The action plan will also explain the mechanism and timing of status reports to the Board and interested stakeholders. If the proposed mitigation involves pumping curtailment, staff recommends that affected pumpers have the first opportunity to propose an action plan to meet the desired outcome.

In the 2014 example mentioned above, District and retailer staff collaborated quickly and effectively to reduce localized pumping and minimize the risk of subsidence. Similarly, it is expected that some issues can be effectively resolved at the staff level, with ongoing reporting to the Board Committee and stakeholders as appropriate. However, effective action plans for more severe, challenging, or widespread issues may need to be elevated to allow for more extensive input. In these cases, it may be appropriate to develop the action plan in consultation with all potentially interested stakeholders through the open forum of the Board Committee.

Step 6: Voluntary Action (Preferred Option)

Staff, affected pumpers, and other interested stakeholders will work to finalize an action plan that is likely to be effective in addressing the identified issue. This is the preferred option, which avoids resorting to the need to potentially regulate pumping under SGMA authorities. If

agreement for voluntary action is reached, all entities responsible for implementing the action plan will need to concur with the action plan prior to implementation.

Step 7: Potential Well/Pumping Regulation, if Needed

The District and affected pumpers may not reach consensus on a voluntary action plan or implementation of a voluntary action plan may not prove effective in addressing the identified issue. In those cases, the District may need to consider implementing any of the authorities provided by SGMA under the following process:

1. Discuss groundwater conditions and the potential need for pumping regulation at the Water Conservation and Demand Management Committee and receive input from the Committee and stakeholders;
2. Implement action recommended by the Committee, which may include, but not be limited to, discussion with the full Board, further District action, or additional attempts to reach consensus on voluntary action;
3. Prepare a draft ordinance to regulate groundwater extraction in accordance with Water Code §10726.4 or otherwise exercise authorities provided by SGMA; and
4. Conduct a public hearing for Board consideration of the proposed ordinance.

Step 8: Implementation, Monitoring, and Reporting

The District, affected pumpers, and other identified stakeholders will implement the voluntary and/or mandatory actions described in the action plan and/or ordinance. District staff will monitor the status of action commitments, groundwater conditions, and performance in meeting the desired outcome. Related reporting to the Committee and/or Board as well as interested stakeholders will be in accordance with the action plan or ordinance. Based on the monitoring results and progress toward meeting the desired outcome, operations may return to normal or the voluntary/mandatory action may need to be modified. Successful execution of this step will require close tracking/monitoring and good communication.

TIME FRAME FOR IMPLEMENTATION OF THE PROCESS

There are no fixed time frames assigned to each step above due to the wide range of possibilities in terms of potential issues and related action needed, including whether it is voluntary or mandated. Staff anticipates that, for more manageable issues, effective voluntary action could be implemented within six months. More severe or widespread issues may take longer to address, even through voluntary action, as they may require consideration by a city council, board, or regulatory agency, or due to implementation lead time.

It is expected that if pumping regulation became necessary, implementation of the process listed under Step 7 would take several months to provide adequate noticing and opportunity for input. This time frame should be considered to correspond to the most extreme and severe conditions, with more time likely needed to fully engage potentially affected pumpers and interested stakeholders on this complex and controversial issue.

The severity of the issue will correspond to the response, with more resources and urgency allocated to more extreme issues. In any case, the District will work to expedite an effective response to minimize the risks to beneficial users or groundwater resources, and will remain committed to prioritizing voluntary collaboration over regulation whenever possible.

Valley Water

Santa Clara Valley Water District
5750 Almaden Expressway, San Jose, CA 95118-3686
Phone: (408) 265-2600 Fax: (408) 266-0271
www.valleywater.org

© 2020 Santa Clara Valley Water District • 01/2020 • PUB 615 • JA